# PHYS 323 Modern Optics

**Course Description:** A study of geometrical and physical optics.
**Prerequisite:** Physics II (PHYS 222) and its associated Calculus III (MATH 291).

**Instructor:** Michael J. Ruiz, Ph.D. in theoretical physics from the University of Maryland.
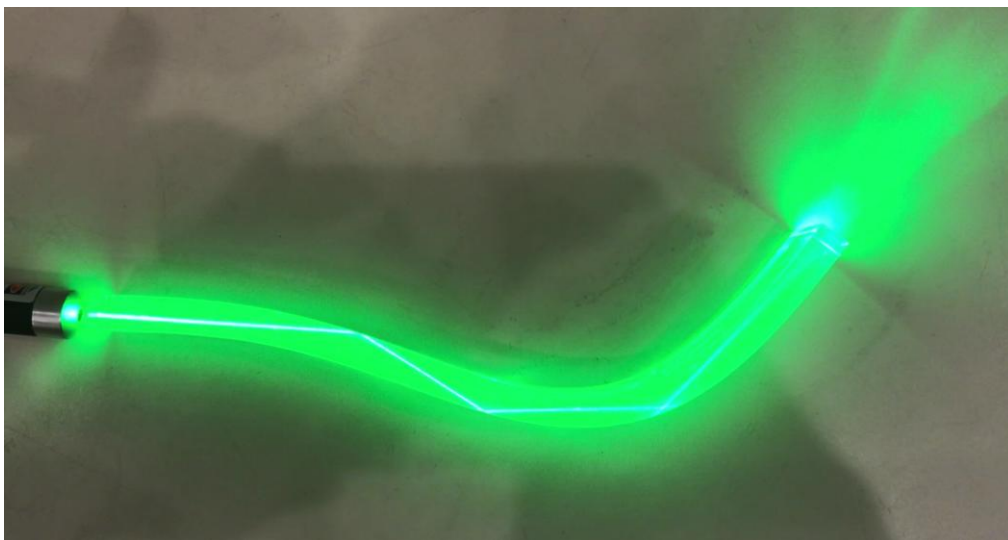**Email: ruiz@unca.edu**        **UNC Asheville (UNCA)**

## August 2020

| Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|
| 3 | 4 | 5 | 6 | 7 |
| 10 | 11<br>A. Principle of Least Time | 12 | 13<br>B. Snell's Law, Mirages | 14<br>Last Day to Drop/Add |
| 17 | 18<br>C.<br>Rainbows | 19 | 20<br>D.<br>Mirrors | 21 |
| 24 | 25<br>E. Lenses & Lens Maker Formula | 26 | 27<br>F. Thick Lenses | 28 |
| 31 | | | | |

**Text:** Optics by Michael J. Ruiz (posted as we go)        **Lectures:** YouTube (posted as we go)



Academic Integrity: Honor Code taking Exams with Closed Book.
However, you are encouraged to work on homework together as
long as you write up the solution in your own words and style.

## September 2020

| Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|
| | 1<br>G.<br>Camera<br>f/# | 2 | 3<br>H.<br>Camera<br>Lenses | 4 |
| 7<br>LABOR DAY | 8<br>I.<br>Eyeglasses | 9 | 10<br>J. Microscope<br>Telescope<br>Eclipses | 11 |
| 14 | 15<br>Exam E1<br>(A-G)<br>3:00 pm | 16 | 17<br>K.<br>Aberrations<br>Dispersion | 18 |
| 21 | 22<br>L. Waves,<br>Phasors &<br>Packets | 23 | 24<br>M. E&M<br>Waves<br>Light Speed | 25 |
| 28 | 29<br>N. Interfaces<br>Fresnel<br>Equations | 30  Break | | |

**Class Meetings:** Asycnhronous Online.

## Class Responsibilities and Resources

**1. Text: Optics**

**2. Videos: YouTube** (doctorphys), **Playlist:** Modern Optics

**3. Homework:** Homework sets are due 11:59 pm on the class letter date that is two letters beyond. For example Homework for Class A is due Class C day; Class B is due Class D, etc.

**4. Homework Format: a) neat (recopy from your scrap paper), b) one pdf file less than 25 MB, c) clearly readable in size, d) clearly readable in contrast, e) problems in order.**

**5. Office Hours:** Zoom Office hours T and R from 3 pm to 4 pm. You will be sent the link.

**6. Peers:** Working with peers on assignments is encouraged. But write it up in your own style.

## October 2020

| Monday | Tuesday | Wednesday | Thursday | Friday |
|--------|---------|-----------|----------|--------|
| | | | 1<br>O.<br>Polarization<br>Birefringence | 2 |
| 5 | 6<br>P.<br>Rayleigh<br>Scattering | 7 | 8<br>Q.<br>Waves in<br>1D, 2D, 3D | 9<br>Last Day to<br>Withdraw is<br>10/09/2020* |
| 12 | 13<br>Exam E2<br>(H-N)<br>3:00 pm | 14 | 15<br>R.<br>Fourier<br>Optics | 16 |
| 19 | 20<br>S.<br>Fraunholfer<br>Diffraction | 21 | 22<br>T.<br>Fresnel<br>Diffraction | 23 |
| 26 | 27<br>U.<br>Wave Guides<br>Fiber Optics | 28 | 29<br>V.<br>Fabry-Pérot | 30 |

*Always double check withdrawal dates with the Registrar's Website.

## Grading
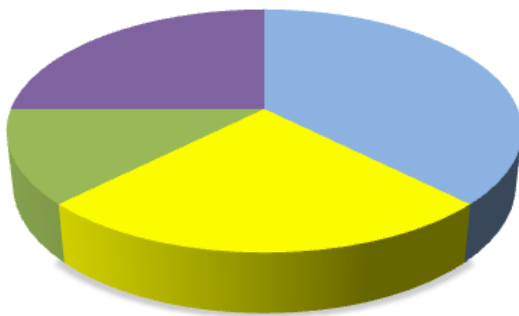


Exams    Final    Best Exam PCT    Homework

**Borderline Cases:** If your grade is near the borderline (10 points away), I will consider helping you if you have turned in 90% of the homework. In addition, I may look for a strong performance on the Final Exam, depending on the grade sought after.

| | | |
|---|---|---|
| 100 | Exam 1 | A (740-800) - apply knowledge in new areas |
| 100 | Exam 2 | B (660-739) - apply knowledge in familiar areas |
| 100 | Exam 3 | C (580-659) - apply knowledge in easy areas |
| 200 | Final | D (500-579) - misconceptions in principles |
| 100 | Best Exam Percentage | F (0-499) - serious gaps in understanding |
| 200 | Homework (Due on Tuesdays) | |
| 800 | **Total** (No ± Grades, See Right) | |

UNCA is committed to making courses accessible to persons with documented special learning needs. To apply, register with the Office of Academic Accessibility and then contact me ASAP.

## November 2020

| Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|
| 2 | 3 <br> W. Lasers and Coherence | 4 | 5 <br> X. Planck's Law and Radiometry | 6 |
| 9 | 10 <br> Exam E3 (O-U) <br> 3:00 pm | 11 | 12 <br> Y. Bohr Atom And Spectroscopy | 13 |
| 16 | 17 <br> Final Exam FN (A-Y) <br> 3:00 pm | 18 <br> FINALS WEEK | 19 <br> FINALS WEEK | 20 <br> FINALS WEEK |
| 23 | 24 <br> Grades Assigned | 25 <br> *Thanksgiving Begins* | 26 | 27 |
| 30 | | | | |

**1. Time.** Reserve at least 3 hours (organizing your notes, study, doing homework, etc.) for every hour of class. This amounts to at least 9 hours per week in addition to class time. If you are a full-time student and have a job, you should NOT work more than 15-20 hours per week.

**2. Instructor.** Drop by during office hours if you are confused.

**3. Peers.** Work with your classmates as long as your homework is in your own words and style.

## Goals/Outcomes

**1. Optics.** You will acquire a solid foundation in geometrical and physical optics.

**2. Math Physics.** You will enhance your math for advanced work in physics and engineeing.

**3. The Literature.** I will incorporate about 10 of my publications into the course. See last page.

**4. The Derivation.** You will understand many derivations, one of the hallmarks of physics.

**5. The Numerical Result**. You will do precise calculations, one of the hallmarks of engineeing.

**6. Interdisciplinarity.** You will learn about interdisciplinary applications, hallmarks of the power of physics and a liberal arts school: camera optics, medical optics, optical instruments, etc.

**7. Theoretical Physics**. You will trained to think as a theoretical physicist since your instructor is one. By studying under different Ph.D. professors, you get a well-rounded physics education.

## December 2020

| Monday | Tuesday | Wednesday | Thursday | Friday |
|--------|---------|-----------|----------|--------|
|  | 1 | 2 | 3 | 4 |
| 7 | 8 | 9 | 10 | 11 |
| 14 | 15 | 16 | 17 | 18 |
| 21 | 22 | 235 | 24 | 25 |
| 28 | 29 | 30 | 31 | |

Michael J. Ruiz, "Dioptres for a Myopic Eye from a Photo" *Physics Education* **54**, 065010 (November 2019) **pdf** and **Video Abstract**

Michael J. Ruiz, "Road Mirage Angle" *Physics Education* **54**, 065009 (November 2019). **pdf** and **Video Abstract**

Patrick Foo (Department of Psychology) and Michael J. Ruiz, "Inexpensive Endoscope Activities," *Physics Education* **54**, 055005 (September 2019). **pdf** and **Video Abstract**

Michael J. Ruiz, "Video of Scenery During a Total Eclipse: Luminance and Effects of Solar Limb Darkening," *Physics Education* **54**, 035001 (May 2019). **pdf** and **Video Abstract**

Gerson Morales (UNCA Engineering Student at Time of Research), James Perkins, Herb Pomfrey, and Michael J. Ruiz, "Accurate Pinhole Camera Apertures Using Insect Pins," *Physics Education* **54**, 025002 (March 2019). **pdf** and **Video Abstract**

Michael J. Ruiz, "Depth of Field and the Vanishing Fence," *Physics Education* **53**, 055015 (September 2018). **pdf** and **Video Abstract**

Halima Flynt (UNC Asheville Art Student) and Michael J. Ruiz, "Making a Room-Sized Camera Obscura," *Physics Education* **50**, 19 (January 2015). Chosen by the Editors as a Highlight of 2015. **pdf** and **Video Abstract**

M. J. Ruiz and T. L. Robinson (UNCA Music Student), "Illusions With Plane Mirrors," *The Physics Teacher* **25**, 206 (April, 1987). **Cover** Article. **pdf**

M. J. Ruiz, "Camera Optics," *The Physics Teacher* **20**, 372 (September 1982), an invited article and **cover** article. **pdf**