**UNIVERSITY OF THE PHILIPPINES**

**Applied Physics 167: Applied Optics**
**1st Semester AY 2022-2023**

**COURSE GUIDE**

## COURSE DESCRIPTION

Imaging optics and electronics, 3D imaging, microscopy, holography, coherence theory, interferometry, Fourier optics, spectroscopy, and nonlinear optics.
Prerequisite: Physics 165
Credit: 3 units

## COURSE GOALS

At the end of the course, the learner is expected to be able to:

1. Demonstrate advanced understanding of the principles of optical systems and methods.
2. Derive intrinsic and extrinsic parameters of optical systems.
3. Design and test optical metrology systems.
4. Perform measurements using optical systems.

## COURSE OUTLINE WITH STUDY SCHEDULE

| Week Number | Module/ Topic | Activity and Assessment |
|---|---|---|
| 1 Sep 12 | Class Orientation | |
| 1 Sep 14 | Imaging optics and electronics - pinhole camera model | Experiment |
| 2 - Sep 19,21 | Pinhole camera model and aberrations | Computation |
| 3 - Sep 26,28 | High dynamic range imaging | Group work |
| 4 - Oct 3,5 | Modulation transfer function | Experiment |
| 5 - Oct 10 | Basic microscopy; numerical aperture and resolution | Hands-on |
| Oct 12-18 | Reading Break | |
| 6 - Oct 19 | Nonlinear optics; second order harmonic generation; atoms in intense fields | Lecture |
| 7 - Oct 24,26 | Spectroscopy; Light sources, Light-matter interaction | Group work |
| 8 - Oct 31 | Color; Properties of human visual system | Group work |
| 9 - Nov 7,9 | Color order systems and color matching functions; color appearance phenomena | Computation |

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| 10 - Nov 14,16 | Color difference specification; Camera spectral sensitivity | Computation |
| 11 - Nov 21,23 | Fourier Optics; Fourier treatment of wave propagation, 4F setup and spatial filtering | Simulation |
| 12 - Nov 28 | Coherence theory | Lecture |
| 13 - Dec 5,7 | Interferometry | Experiment |
| 14 - Dec 12,14 | Holography; Hologram recording and reconstruction, Digital Holography | Simulation |
| 15 - Dec 19, 21 | Catch-up | |
| 16 - Jan 2,4 | Catch-up | |

**COURSE REQUIREMENTS**
Project Reports - 100%

**COURSE GUIDELINES**

1. Mode of teaching is active learning. Activities include simulations, individual experiments, group work, problem solving.
2. Reports are by default slide presentation style. Occasionally I will require SPP-paper type reports.
3. Non-graded quizzes will be given to check on the students' grasp of concepts and to catch and correct misconceptions.
4. Groupings are not fixed.
5. Classes will begin at 10:10AM and will be dismissed at 11:25AM.
6. Classes, activities and demos will occasionally be held at the Advanced Lab (R209) or outdoors.

**ABOUT THE INSTRUCTOR**

Maricor Soriano, Ph.D Room R202
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**REFERENCES**

1. Optics 5th ed., by E. Hecht, Pearson (2016)
2. Handbook of Optics Vol. I , OSA (2010)
3. Introduction to Fourier Optics 3rd ed., by J. Goodman, Roberts and Company Publishers (2004)
4. Basics of Interferometry 2nd ed., by P. Hariharan, Academic Press (2007)
5. Optical Physics, 3rd ed. by Lipson, Lipson & Tannhauser (1995)
6. Debevec, Paul E., and Jitendra Malik. "Recovering high dynamic range radiance maps from photographs." ACM SIGGRAPH 2008 classes. ACM, 2008.
7. Herrera, C., Juho Kannala, and Janne Heikkilä. "Joint depth and color camera

calibration with distortion correction." Pattern Analysis and Machine Intelligence, IEEE Transactions on 34.10 (2012): 2058-2064.
8. Zimmermann, Timo. "Spectral imaging and linear unmixing in light microscopy." Microscopy techniques. Springer Berlin Heidelberg, 2005. 245-265.
9. Schalkoff, Robert J. Digital image processing and computer vision. Vol. 286. New York: Wiley, 1989.