

ECE 8562 Introduction to Photonics Fall 2020

Villanova University
Department of Electrical and Computer Engineering

Instructor

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Office Hours

Tues. 12 p.m. – 1:30p.m.
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Thur. 5 p.m. - 6p.m.
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other times by appointment

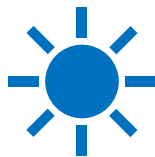
(Please allow 3 business days for your questions to be answered.)

Course Description



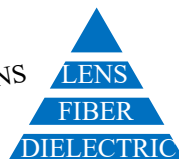
This course introduces the basic descriptions of light as rays (geometrical optics), waves (physical optics), and photons. Photonic principles will be introduced together with applications to basic optical systems such as single-lens imaging, microscopes, scanning systems, concentrators, etc. This course will describe light propagation through optical fibers for telecommunications, “smart structure” sensors, “non-destructive evaluation” and “green” photonics applications. The interference and diffraction of propagating optical waves are examined with applications to optical metrology, the resolution of imaging systems and “non-destructive evaluation” sensing. Regarding light as photons, a brief introduction to absorption, emission, and luminescence phenomena is followed by hands-on exercises employing light emitting diodes, lasers and optical detectors. This course will address specific application including optical sensors for environmental and biochemical applications. For example, topics such as optical air pollution and water quality monitoring, organic photovoltaics, optical sensors for infrastructure monitoring and biophotonic microbe monitors will be reviewed.

GRAPHICAL SYLLABUS



Input

LASERS, LED, PHOTONS



Function

INTERFERENCE,
DIFFRACTION,
MUX/DEMUX



Output

Student Centered Learning Objectives

- To understand basic optical design with simple optical components. (*assessed by HW assignments, HS exercises, and Exams*)
- To understand the fundamental principles of operation of a broad range of photonic devices and optical communication systems including photodetectors, light emitting diodes, gas lasers, optical modulators, and semiconductor lasers. (*assessed by HW assignments, HS exercises, Blogs, Projects, and Exams*)
- Address application topics including optical sensors for environmental and chemical applications. For example, optical air pollution and water quality monitoring, transparent photovoltaics, optical sensors for infrastructure monitoring and biophotonic microbe monitors will be reviewed. (*assessed by Blogs, and Projects*)

Textbook

B.E.A. Saleh and M.C.Teich, “*Fundamentals of Photonics*”, 3rd Edn. Wiley, 2019.
ISBN: ISBN: 978-1-119-50687-4

References

Amnon Yariv, “*Photonics: Optical Electronics in Modern Communications*”, Sixth Edition, Oxford University Press, 2005/6
S.O. Kasap, “*Optoelectronics and Photonics*”, 1st. Edn. Prentice-Hall, 2001.

Course Policies

Attendance is expected at exams/projects. A make-up exam/project will only be given in verifiable emergencies or commitment to university sports. Exams will be offered on the Blackboard system with a +/-3day window from the exam date to complete with an automated timer that is activated when the exam content is accessed and stopped when the exam answers are submitted for grading. Project may be recorded and submitted via Blackboard system.

Accommodations -Students with disabilities who require academic accommodations should schedule an appointment to discuss specifics with me. The Office of Disability Services collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The ODS provides Villanova University students with *physical disabilities* the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact *Gregory Hannah, advisor to students with disabilities @ 610-519-3209* or visit the office on the second floor of the Connelly Center.

ECE 8562 Schedule (Tentative)

Date	Topic	Chapter
18-Aug	Introduction/ Ray Optics, HS, Blog 1	1
25-Aug	Wave Optics	2
1-Sep	Wave and Gaussian Beam Optics, HW#1 assigned, HS, Blog 2	2-3
8-Sep	Fourier and EM Optics, Blog 3	4-5
15-Sep	Optical Components: Wave Propagation in Periodic Media, HW#1 due, HS, Blog 4	7
22-Sep	Optical Components: Guided Waves in Dielectric Slabs and Fibers, HS, Blog 5	9-10
29-Sep	Exam #1	
6-Oct	Lab, Presentation topics due w/ references	
13-Oct	Theory of Laser oscillation/ Optical Components: Optical Resonators, HW#2 assigned, HS, Blog 6, Consult	11;14
20-Oct	Detection of Optical Radiation, HS, Blog 7, Consult	14;19
27-Oct	Optical Components: Optical Amplifier, HW# 2 due, HW#3 assigned, HS, Blog 8, Consult	15
3-Nov	Specific Laser Systems, HS, Blog 9, Consult	16-17
10-Nov	Optical Components, Semiconductor Lasers, Optical Modulation, HW#3 due, HS, Blog 10	18, 20, 21
17-Nov	Project Presentations Due	
24-Nov	Reading Day	
5-Dec	Exam #2 (Tentative) (Tue. 8:30am- 11:00am)	

Grading

Homework	20%
HS/Blogs	20%
Labs	15%
Exams/Projects	<u>45%</u>
Total	100%

Assignments (Sees Appendix for assessment rubric examples)

- Hot Spots: Answer Top Hat quantitative questions
- 1st Blog review (qualitative): Highlight errors and explain what the error is cite principles or textbook page to support your claims
- 2nd Blog review (qualitative): Find article/video illustrations of concept for another classmate's blog (via JoVE, YouTube, MIT creative Commons, NASA, etc.) submissions must be unique and cite different sources
- Homework: 3 Sets (3 quantitative problems each)
- Article/Product Review: 1-2 Presentations (20-30 minutes)⁺
- Appointments: 30 mins/student for technical presentation reviews consultation
- Project/Exam: either a Power Point Presentation (20 minutes) or Written Exam (2 hours and 40 minutes)

+Article /Product Review: Students will individually present a recent magazine/journal article or current product relevant to your technical interests that are related to topics covered in this course (i.e. lasers diodes, waveguides, etc.).

- Provide appropriate description/illustration and discuss device applications or technical relevance.
- Presentation should be 20 minutes long and include Power point slides.
- Students are expected to ask at least two unique questions during the live presentation or via Blog
- Telephone conferencing or audio-recorded slides (within specified guidelines) are acceptable.

Academic Integrity

The College of Engineering is committed to creating an environment of academic integrity and ethical decision-making that we hope is reflected in the actions of our students and graduates. As Villanova students, integrity is central to the University mission. As engineers, our code of conduct requires us to place honor and integrity at the forefront of everything we do. As engineering students, it is expected that you will begin to adopt these values and instill them into your work habits. Students violating the academic integrity policy will receive a zero on that assignment or exam and the violation will be reported to the Associate Dean for Academic Affairs.

Students are encouraged to read the [University's academic integrity policy](#).

The College of Engineering has adopted the following exam guidelines:

- Each student must write and sign the following statement, *"I have neither given nor received any unauthorized assistance in the completion of this exam."*

Adherence to the Student Code of Conduct and the CARITAS Commitment

Students are expected to act in a professional and respectful manner to their fellow students, faculty, and staff. Students should become acquainted with and understand the responsibilities set forth in the Student Handbook, especially those in the sections on Policy and Regulations. Adherence to University regulations is expected and required for successful completion of the program of studies. Enforcement within the classroom of policies regarding classroom behavior is the responsibility of the faculty member. All other discipline problems are to be referred to the Dean of Students.

Students, faculty, and staff are expected to comply with the [CARITAS Commitment](#). Students must wear masks, practice social distancing and good hygiene, wipe down their work area upon arrival and departure, and request an excused absence if they are not feeling well.

Excused Absences

Please complete the excused absence form

(https://www1.villanova.edu/content/villanova/engineering/students_secure/forms/studentAbsence.html)

and the Dean's Office will inform you if the absence has been excused.

Inclusive Classroom

We consider this classroom to be a place where you will be treated with respect; and, we welcome individuals of all ages, backgrounds, beliefs, ethnicities, gender, gender identities and expressions, sexual orientation, and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class.

Online Expectations To foster a professional environment, please wear appropriate clothes, mute if you are not talking to cut down on background noise, refrain from eating, and select an appropriate setting when we are meeting online.

Assignments and Assessments All assignments are to be submitted online on Blackboard in PDF format. You will be required to use the Respondus lockdown browser and other related tools during assessments. All assignments are to be submitted individually.

Copyright Policy

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