Modern Optics
01:750:305
Fall 2020

Instructor: Professor Girsh Blumberg

Summary: Geometrical optics; electromagnetic waves, the wave equation; superposition, interference, diffraction, polarization, and coherence; holography; multilayer films, Fresnel equations; blackbody radiation, Einstein coefficients, lasers; waveguides and fiber optics; optical properties of materials.

This course is required for the Applied Option.

Pre-requisites: 01:750:227-228 or 01:750:272-273 and 01:640:251 (Calc3)

Co-requisites: None

Meeting times: Two 80 minute lectures per week
Lectures: MW 6 (5:00 pm to 6:20 pm)

Text: None required, recommended references:
F.L. Pedrotti et. al., Introduction to Optics: Third Edition, Cambridge University Press (2018).
E. Hecht, Optics: 5th Edition, Pearson Education (2016).
G. R. Fowles, Introduction to Modern Optics, Wiley, 2nd Ed. (1989).
M.V. Klein and T.E. Furtak, Optics, 2nd Ed. (1986).
M. Born and E. Wolf, Principles of Optics: Electromagnetic Theory, 7th Ed. (1999).
J. D. Jackson, Classical Electrodynamics, 3rd Ed., John Wiley & Sons, Inc., (1998).

LMS: Sakai

Provisional Plans for Remote Instruction: The primary course material will be presented in synchronous lecture-based meetings. The lecture portions will be recorded and posted to the LMS, and available to all students asynchronously. Office hours (likely multiple per week) will be scheduled based on student availability, with additional meetings by appointment.

Technology requirements: Students will need access to a computer capable of (a) using web conferencing software to attend the synchronous lectures, (b) viewing recorded videos on the LMS website, (c) at least 100 Mbps internet connection.

Provisional Grading Plans: 40% homework and 60% oral final exam.

Homework: Homework problems will be assigned, collected, and graded on weekly basis. All homework and the deadlines will be posted on the Sakai course webpage. Students are requested to turn in their homework assignments electronically via Sakai. A copy of all solutions must also be organized and saved in student's Sakai Drop Box. Homework will be graded on a 10 points scale. Late submissions will not be accepted.
Project: None (provisional)
Mid-term: None (provisional)
Final Exam: Individual oral format (provisional)

Schedule (provisional):

Lecture	Week	Date	Topic
1	week 1	9/2	Introduction. Light. Its nature and brief history of optics.
2	week 2	9/7	Wave motion. Wave equations. Energy and momentum of EM waves.
3		9/9	Geometrical optics. Reflection & refraction. Fermat's principle. Snell's
4	week 3	9/14	Geometrical optics. Curved reflecting surfaces.
5		9/16	Geometrical optics. Refraction. Mirrors and lenses.
6	week 4	9/21	Geometrical optics. Paraxial rays and lenses.
7		9/23	Optics of the eye. Aberration theory. TIR Optical systems, eyeglasses.
8	week 5	9/28	Optical instrumentation.
9		9/30	***Review I (provisional)***
10	week 6	10/5	Thermal radiation and light quanta. Photoelectric effect.
11		10/7	Wave optics. EM theory of light. Macroscopic Maxwell's eqs.
12	week 7	10/12	Fresnel equations.
13		10/14	Light coherence, superposition and interference.
14	week 8	10/19	Double and multi-beam interference. Young's experiment.
15		10/21	Newton's rings. Interferometers. Thin films.
16	week 9	10/26	Polarization optics. Malus's law. Dichroism, birefringence, retarders.
17		10/28	***Review II (provisional)***
18	week 10	11/2	Discussion of Review II (Recitation).
19		11/4	Diffraction. Huygens-Fresnel principle.
20	week 11	11/9	Fraunhofer diffraction I.
21		11/11	Fraunhofer diffraction II. Diffraction grating.
22	week 12	11/16	Fraunhofer diffraction III. Diffraction grating. Poisson-Arago spot.
23		11/18	Fresnel diffraction I. Airy pattern. Aperture resolution. Zone plates.
24	week 13	11/23	Fresnel diffraction II. Cornu spiral. Babinet's principle.
		11/25 ***(Friday sch)***	No lecture
25	week 14	11/30	Polarization optics. Malus's law. Dichroism, birefringence, retarders.
26		12/2	Holography
27	week 15	12/7	Optical Spectra. Rutherford-Bohr model.
28		12/9 ***(Last class)***	Review.

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Students are expected to maintain the highest level of academic integrity. You should be familiar with the university policy on academic integrity: http://academicintegrity.rutgers.edu/academic-integrity-policy/ Violations will be reported and enforced according to this policy.

Use of external sources to obtain solutions to homework assignments or exams is cheating and a violation of the University Academic Integrity policy. Cheating in the course may result in penalties ranging from a zero on an assignment to an F for the course, or expulsion from the University. Posting of homework assignments, exams, recorded lectures, or other lecture materials to external sites without the permission of the instructor is a violation of copyright and constitutes a facilitation of dishonesty, which may result in the same penalties as explicit cheating.

Not only does the use of such sites violate the University's policy on Academic Integrity, using such sites interferes with your achievement of the learning you are paying tuition for. Assignments, quizzes, and exams are given not simply to assign grades, but to promote the active learning that occurs through completing assignments on your own. Getting the right answer is much less important than learning how to get the right answer. This learning is critical to your success in subsequent courses and your careers.

Student wellness Services
Student Counseling, ADAP & Psychiatric Services (CAPS) wellness for non-emergency psychological health issues services (848) 932-7884, 17 Senior Street, New Brunswick, NJ 08901
http://health.rutgers.edu/medical-counseling-services/counseling/

Violence Prevention & Victim Assistance (VPVA), (848) 932-1181, 3 Bartlett Street, New Brunswick, NJ 08901, http://www.vpva.rutgers.edu/

Office of Disability Services (848) 445-6800, Lucy Stone Hall, Suite A145, Livingston, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854, https://ods.rutgers.edu/

Scarlet Listeners for confidential peer counseling and referral hotline, (732) 247-5555,
http://www.scarletlisteners.com