ENG PHYS 3E03 and PHYSICS 3N03
Fundamentals of Physics Optics / Physical Optics
Fall/Winter 2018/19
Course Outline

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

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Office Hours:
By appointment.

PRE-REQUISITES AND ANTI-REQUISITES

Eng Phys 3E03: Prerequisite(s): Registration in any Engineering Physics Program; one of ISCI 2A18 A/B, MATH 2A03, 2Q04, 2XX3, 2ZZ3; and one of MATH 2C03, 2P04, 2Z03; and one of MEDPHYS 2B03, PHYSICS 2B06, 2BB3 or both ENGPHYS 2A04 (or 2A03) and 2E04 Cross-list(s): PHYSICS 3N03

Physics 3N03: Prerequisite(s): One of ISCI 2A18 A/B, MATH 2A03, 2Q04, 2X03, 2ZZ3; and one of MATH 2C03, 2P04, 2Z03; and one of MEDPHYS 2B03, PHYSICS 2B06, 2BB3 or both ENGPHYS 2A04 (or 2A03) and 2E04 Cross-list(s): ENGPHYS 3E03

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

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Office Hours:
All by appointment

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

http://avenue.mcmaster.ca/

COURSE OBJECTIVES

By the end of the course, a successful student will be able to:

- Solve a range of problems in the domain of geometrical optics
- Demonstrate a good understanding of the wave nature of light
- Demonstrate a good understanding of the principle of superposition – leading to the interference of light in a wide range of situations, including diffraction phenomena.

- Be able to solve problems connected with the operation of optical instruments which directly exploit light wave interference.

- Explain the relation of the optical properties of materials and selected mechanisms for the generation of polarized light.

- Solve problems involving simple waveguides and the propagation of light in modulated media

- Understand the application of boundary conditions in electromagnetic problems, and in particular the development and implications of Fresnel's equations

- Be capable of solving problems connected with the domain of light-matter interactions

MATERIALS AND FEES

Required Text: {new}

The text for this course is "Introduction to Optics", 3-rd edition, by Pedrotti, Pedrotti, Pedrotti (Cambridge 2017)

Recommended Additional Texts:

"Optical Physics", 4-th Edition, Ariel Lipson, Stephen Lipson, and Henry Lipson (Cambridge University Press, 2010)

"Optics", 5-th Edition, Eugene Hecht (Pearson, 2016)

"Introduction to Modern Optics", 2-nd edition {Paperback}, Grant Fowles (Dover, 1989)

Calculator:

Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the Campus Store.

COURSE OVERVIEW

This is a combined course for Eng Phys 3E03 "Fundamentals of Physical Optics" and Physics 3N03 "Physical Optics". It deals almost entirely with physical optics, although some practical aspects of geometrical optics will also be covered.

The breakdown of the general topics to be covered is:

- Waves
- Geometrical optics
- Fourier theory and optical applications
- Electromagnetic waves
- Polarization and anisotropic media
- Scalar theory of diffraction
- Fraunhofer diffraction and interference

- Interferometry
- Optical waveguides and modulated media
- Coherence
- Classical theory of dispersion
- Quantization of the electromagnetic field and introduction to quantum optics
- Selected additional topics in modern optics (e.g. super-resolution microscopy, negative refractive index materials, non-linear optics)

Details of the sub-topics to be covered, and the correspondence with the text, will be outlined during term. (Note: I believe in avoiding the goals of strict coverage of material in terms of the details. Rather than such a philosophy, which is captured by the old movie title "If It's Tuesday, This Must Be Belgium", we will aim to emphasize and understand the main ideas of the discipline.)

ASSESSMENT

Component	Weight #1	Weight #2	Weight #3
Assignments	20%	20%	20%
Tests	40%	20%	0%
Final Exam	40%	60%	80%
Total	100%	100%	100%

Note 1: You will be given the best evaluation scheme, provided that the stipulation of Note 3 is satisfied.
Note 2: Weight #2 incorporates your best test (uses one of the two tests).
***Note 3**: In order to be offered the best score of the three schemes, it is necessary that one writes the tests and scores at least 25% on each of them to be able to benefit from the options. Please be careful not to "cut things too close" in preparing for the tests.*

ROADMAPS IN ENGINEERING PHYSICS, AND IN PHYSICS AND ASTRONOMY

The main physics and engineering foundations for this course are obtained respectively, for Engineering Physics via EP 2A04, and for Physics and Astronomy via Physics 2B03 and 2BB3. In terms of mathematics, the main background is acquired respectively, for Engineering Physics via Math 2Z03 and 2ZZ3, and for Physics and Astronomy via Math 2C03. (Partial differential equations, which arise in our optics course, are treated in the Physics and Astronomy program via Math 3C03.)

Other elective courses in Engineering Physics which connect quite closely with EP 3E03 are EP 3G04, EP 4S03 and EP 4I03. Note that EP 3E03 is not required for EP 3G04 which is a practical course on photonic instrumentation, nor is it required for EP 4I03 which is a broader interdisciplinary course on biophotonics. Optics is important in other elective courses in Engineering Physics, like EP 4X03 (photovoltaics), EP 4Z03 (semiconductor manufacturing technology), and 4U02 (photonics section).

The follow-up course in Physics and Astronomy which is quite closely linked to Physics 3N03 is Physics 4B03, electromagnetic theory. That said, optics is a pervasive and enabling discipline. So even if other course offerings in Physics and Astronomy are not specifically aimed at more advanced treatments of optics, it plays an important role in various disciplines, including condensed matter physics, astronomy, and biophysics. In addition, our third year lab

course, Physics 3H03, offers opportunities to explore various aspects of optical interferometry and semiconductor laser based spectroscopy.

In terms of fundamentals, someone who is interested in exploring the wide domain of optics further should aim for the areas of nonlinear optics and quantum optics.

ACCREDITATION LEARNING OUTCOMES (THIS SECTION PERTAINS ONLY TO ENGINEERING)

Our detailed learning outcomes are repeated below. Their association with various graduate attribute indicators are shown in this section. These indicators are being measured for engineering accreditation purposes.

Students will learn to:

- Solve a range of problems in the domain of geometrical optics [indicator 1.2, 1.4]
- Demonstrate a good understanding of the wave nature of light [indicator 1.2, 1.3]
- Demonstrate a good understanding of the principle of superposition – leading to the interference of light in a wide range of situations, including diffraction phenomena. [indicator 1.2, 1.3]
- Be able to solve problems connected with the operation of optical instruments which directly exploit light wave interference. [indicator 1.4]
- Explain the relation of the optical properties of materials and selected mechanisms for the generation of polarized light. [indicator 1.2, 1.4]
- Solve problems involving simple waveguides and the propagation of light in modulated media [indicator 1.3]
- Understand the application of boundary conditions in electromagnetic problems, and in particular the development and implications of Fresnel's equations [indicator 1.2, 1.4]
- Be capable of solving problems connected with the domain of light-matter interactions [indicator 1.2]

For more information on Accreditation, please visit: https://www.engineerscanada.ca

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of

credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

ACADEMIC ACCOMMODATIONS

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905-525-9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University’s Policy for Academic Accommodation of Students with Disabilities.

NOTIFICATION OF STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

1. The McMaster Student Absence Form is a self-reporting tool for Undergraduate Students to report absences DUE TO MINOR MEDICAL SITUATIONS that last up to 3 days and provides the ability to request accommodation for any missed academic work. Please note this tool cannot be used during any final examination period.
2. You may submit a maximum of 1 Academic Work Missed request per term. It is YOUR responsibility to follow up with your Instructor immediately (NORMALLY WITHIN TWO WORKING DAYS) regarding the nature of the accommodation. Relief for missed academic work is not guaranteed.
3. If you are absent for reasons other than medical reasons, for more than 3 days, or exceed 1 request per term you MUST visit the Associate Dean's Office (JHE/H301). You may be required to provide supporting documentation.
4. This form must be submitted during the period of absence or the following day, and is only valid for academic work missed during this period of absence.
5. It is the prerogative of the instructor of the course to determine the appropriate relief for missed term work in his/her course.
6. You should expect to have academic commitments Monday through Saturday but not on Sunday or statutory holidays. If you require an accommodation to meet a religious obligation or to celebrate an important religious holiday, you may submit the Academic Accommodation for Religious, Indigenous and Spiritual Observances (RISO) Form to the Associate Dean’s Office. You can find all paperwork needed here: http://www.eng.mcmaster.ca/current/documents.html

NOTICE REGARDING POSSIBLE COURSE MODIFICATION

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

TURNITIN.COM STATEMENT

In this course we will be using a web-based service (Turnitin.com) to reveal plagiarism. Students will be expected to submit their work electronically to Turnitin.com and in hard copy so that it can be checked for academic dishonesty. Students who do not wish to submit their wok to Turnitin.com must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to http://www.mcmaster.ca/academicintegrity/.

ON-LINE STATEMENT FOR COURSES REQUIRING ONLINE ACCESS OR WORK

In this course, we will be using e-mail and Avenue to Learn. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

REFERENCE TO RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf.