ENG PHYS 3E03 and PHYSICS 3N03
Fundamentals of Physics Optics / Physical Optics
Fall/Winter 2016/17
Course Outline

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. H.K. Haugen
ABB 428
haugenh@mcmaster.ca
ext. 23335

Office Hours:
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 wide range of problems in the domain of geometrical optics, along with demonstration of an appreciation of the practical and fundamental limits.
- Be familiar with matrix methods of direct relevance to computer software packages which enable the handling of complex optical designs.
- Demonstrate a good understanding of the wave nature of light, and to further be able to make conceptual connections with classical electromagnetism, including the application of boundary conditions on electric and magnetic fields which leads to Fresnel's equations and their application to optical phenomena at material interfaces.
- Demonstrate a clear 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, as well as with the propagation of light in dielectric and metallic media. Students will be able to predict the modification of the polarization state of light propagating through an optical system using matrix techniques.
- Be capable of solving quantitative problems connected with the domain of light-matter interactions.

MATERIALS AND FEES

Required Texts:

The text for this course is *Introduction to Optics*, third edition, by F.L. Pedrotti, L.S. Pedrotti, and L.M. Pedrotti; publishers, Pearson Prentice Hall (2007).

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 primarily with physical optics. Aspects of geometrical optics will also be covered, as well as a brief presentation of selected topics in modern optics.

The breakdown of the general topics to be covered is:

- Introduction
- Geometrical optics
- Matrix methods for paraxial optics
- Electromagnetic waves
- Interference of light
- Optical interferometry
- Fresnel equations
- Diffraction
- Matrix treatment of light polarization
- Generation of polarized light
- Optical properties of materials
- Selected additional topics in modern optics

Details of the sub-topics to be covered, and the correspondence with the text, will be outlined during term.

ASSESSMENT

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

Note 1: You will be given the best evaluation scheme, provided that the stipulation of Note 2 is satisfied.
Note 2: In order to be offered the best score (Weight #1 versus Weight #2), 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.

ACCREDITATION LEARNING OUTCOMES (THIS SECTION PERTAINS ONLY TO ENGINEERING)

Our detailed learning outcomes are defined 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 problems of modest scope in geometrical optics using an analytical approach. [indicators 1.2, 1.3, 1.4]
- Approach rather simple but open-ended problems in optics which are relevant to the design of experiments for fundamental physics investigations or in high-tech industry. [indicator 4.3]
- Use matrix methods for simple geometrical optics problems which would later enable an experimental physicist or practising engineer to solve complex problems with advanced optical software packages. [indicator 1.4]
- Use matrix methods for determining the resulting polarization of a light beam, with well-defined input polarization, which traverses a series of optical elements. [indicator 1.4]
- Clearly explain the physical foundations behind a variety of mechanisms for producing highly polarized light, including the modification of the polarization state of a beam propagating through anisotropic dielectrics, and further to be able to solve simple numerical problems in this area. [indicators 1.2, 1.4]
- Demonstrate a high level of competence in working with the vectorial and wave nature of light, and to be able to apply this understanding in solving a variety of problems connected, for example, with the Doppler effect, phase and group velocities, and the application of Fresnel equations. [indicators 1.2, 1.3, 1.4]
- Apply the physics of light wave interference to a number of scientific and engineering situations, including thin film optical coatings and the operation of very high precision optical instruments. [indicators 1.2, 1.4]
- Demonstrate a clear understanding of the principles of diffraction, in both a near-field (Fresnel) and far-field (Fraunhofer) regime. [indicator 1.2]
- Solve a number of entry-level diffraction problems analytically, extending to problems involving practical devices, including the Fresnel lens and the diffraction grating. [indicators 1.2, 1.4]
- Explain the essential aspects of the interaction of light with metals and dielectrics, and further be able to apply the fundamental ideas in describing the characteristics of normal and anomalous dispersion, as well as the attenuation of light in various media. [indicators 1.2, 1.4]

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/A214). 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.