

Engineering Physics & Medical Physics 4I03/6I03
Introduction to Biophotonics
2024/25 T2 (Winter)
Course Outline

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

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Office Hours:
by appointment only

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Office Hours:
by appointment only

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

<http://avenue.mcmaster.ca/> & EP 4I03 Microsoft Teams
This course will be offered in person.

COURSE CALENDAR DESCRIPTION

This course covers the basic principles of light interaction with biological systems and specific biomedical applications of photonics such as optical light microscopy, endoscopic imaging, spectroscopy in clinical diagnosis, flow cytometry, micro-optical sensors, etc.

Three lectures; second term

Prerequisite(s): Registration in Level III or above in the Faculties of Engineering, Science, or Health Sciences, or the Integrated Biomedical Engineering & Health Sciences (IBEHS) Program

Cross-list(s): MEDPHYS 4I03, BME 6I03, EP6I03, MEDPHYS 6I03

COURSE OBJECTIVES

By the end of this course, students should be able to:

- Demonstrate good understanding of fundamental principles of light interaction with biological systems;
- Use the optical properties of tissue and calculate penetration depth of light;
- Understand the concept of diffraction limit and its impact to biophotonics applications;
- Following general approaches in biophotonics and develop complete solutions (instruments, protocols, and procedures) for specific biomedical problems;
- Understand laser safety and able to perform safety calculations for specific lasers and their applications.
- Understand basic operating principles of optical microscopy techniques and, through hands-on experiential learning, basic image processing and analysis approaches.
- Perform literature research on Biophotonics related topics using scientific, industry, and other sources.

MATERIALS AND FEES

Required Texts:

Paras N. Prasad, "Introduction to Biophotonics" ISBN: 0471287709

\$230 CAD at <https://www.amazon.ca/Introduction-Biophotonics-Paras-N-Prasad-ebook/dp/B000QCQV2S>

Available online through the McMaster Health Science Library

https://mcmaster.primo.exlibrisgroup.com/permalink/01OCUL_MU/deno1h/alma991001769479707371

Other Materials:

Recommended for 6I03:

Tuan Vo-Dinh, "Biomedical Photonics Handbook" ISBN: 0849311160

\$350 CAD at <https://www.amazon.ca/Biomedical-Photonics-Handbook-Set-Second-dp-1439804443/dp/1439804443>

Available online through the McMaster Health Science Library

https://mcmaster.primo.exlibrisgroup.com/permalink/01OCUL_MU/deno1h/alma991002238019707371

Image Processing

Pérez, José María Mateos.; Pascau, Javier, Image processing with ImageJ : discover the incredible possibilities of ImageJ, from basic image processing to macro and plugin development

\$25 CAD, <https://www.amazon.ca/Image-Processing-ImageJ-Mar%C3%ADa-Mateos/dp/1783283955>

Available online at McMaster Health Science Library

https://mcmaster.primo.exlibrisgroup.com/permalink/01OCUL_MU/deno1h/alma991032469322107371

Calculator:

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

COURSE OVERVIEW

Module	Topic	Readings
1	Relevant optics and biology background review	Textbook & lecture notes
2	Fluorescence spectroscopy and imaging and their biomedical applications	
3	Optical microscopy and biomedical applications in live cell imaging	
2	Tissue Optics and laser safety	
5	Other biophotonics applications: PDT, OCT, Hyperspectral Imaging, etc.	
6	Fundamentals of optical image processing and analysis with a hands-on experiential learning module	

ASSESSMENT

Component	Weight
Assignments	20%
Exams	50%
Midterm: 20%	
Final: 30%	
Term project	30%
Total	100%

ADDITIONAL DETAILS REGARDING COURSE MANAGEMENT AND ASSESSMENT

- Attendance requirements: Required
- Grade adjustment techniques: N/A
- Group work expectations and how group work will be evaluated: N/A
- How work is to be submitted: through Avenue to Learn

ACCREDITATION LEARNING OUTCOMES

Disclaimer: The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be taken into consideration in determining a student's actual grade in the course.

Outcomes	Indicators
1. Understand the fundamental light-tissue interaction mechanisms	1
2. Able to apply the basic principles in biomedical applications	3
3. Good understanding of optical microscopy techniques and instrumentation	1
4. Understand laser safety and able to perform laser safety calculations	3

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 individual work.
3. Using and contributing to unauthorized aids in assignments, tests, and examinations.

This course has a significant essay/report writing component. Use of AI/ML tools such as ChatGPT or alike are not permitted in this course unless it's explicitly allowed.

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.

TURNITIN.COM STATEMENT

In this course we will be using a web-based service (Turnitin.com or similar) 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 work 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 Avenue-to-Learn (including its e-mail) and Microsoft Teams. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, usernames 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>.