Medical Biophysics
Med Bio 3505F Mathematical Transform Applications in Medical Biophysics

Course outline for Fall 2021

Although this academic year might be different, Western University is committed to a thriving campus. We encourage you to check out the Digital Student Experience website to manage your academics and well-being. Additionally, the following link provides available resources to support students on and off campus: https://www.uwo.ca/health/.

1. Technical Requirements:

- Stable internet connection
- Laptop or computer
- Working microphone
- Working webcam

Microphone and webcam will be necessary in the case of Covid resurgence requiring ending of in-person classes.

2. Important Dates:

<table>
<thead>
<tr>
<th>Classes Begin</th>
<th>Classes End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday, September 8, 2021</td>
<td>Wednesday, December 8, 2021</td>
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</table>

* November 12, 2021: Last day to drop a first-term half course without academic penalty

<table>
<thead>
<tr>
<th>Reading Week</th>
<th>Study day(s)</th>
<th>Exam Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 1–7</td>
<td>December 9</td>
<td>December 10–21</td>
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3. Contact Information

<table>
<thead>
<tr>
<th>Instructors</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Neil Gelman (course coordinator)</td>
<td><a href="mailto:ngelman@lawsonimaging.ca">ngelman@lawsonimaging.ca</a></td>
</tr>
<tr>
<td>Dr. Keith St. Lawrence</td>
<td><a href="mailto:kstlaw@lawsonimaging.ca">kstlaw@lawsonimaging.ca</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching Assistants</th>
<th>Contact Information</th>
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</thead>
<tbody>
<tr>
<td>Paul Dubovan</td>
<td><a href="mailto:pdubovan@uwo.ca">pdubovan@uwo.ca</a></td>
</tr>
<tr>
<td>Lucas Narciso</td>
<td><a href="mailto:lnarciso@uwo.ca">lnarciso@uwo.ca</a></td>
</tr>
</tbody>
</table>

4. Course Description and Design

**Delivery Mode:** blended

The role of mathematical transforms in biomedical research. Application of Fourier Transforms for imaging and image analysis. Applications of systems analysis and Laplace Transforms to model complex systems, and of linear time-invariant systems and kinetic models to analyze physiological processes.

**Prerequisite(s):** One of Calculus 1000A/B, Calculus 1500A/B plus one of Calculus 1301A/B or Calculus 1501A/B, or Applied Mathematics 1413; one of Physics 1028A/B, Physics 1301A/B, Physics 1401A/B or Physics 1501A/B, and one of Physics 1029A/B, Physics 1302A/B, Physics 1402A/B or Physics 1502A/B. Although typically taken in third year, this course is available to second-year students with an overall average of at least 70% in first year.

**Extra Information:** 2 lecture hours, 2 laboratory/tutorial hours.

This course will cover two different topics involving the application of mathematical and physical concepts to biology and medicine:
Timetabled Sessions

<table>
<thead>
<tr>
<th>Component</th>
<th>Date(s)</th>
<th>Time</th>
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<tbody>
<tr>
<td>Lecture</td>
<td>T/Th</td>
<td>9:30 – 10:20</td>
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<tr>
<td>Tutorial</td>
<td>W/Th</td>
<td>2:30 – 4:30</td>
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</table>

☑️ Asynchronous pre-work (watching videos) strongly suggested prior to sessions
☑️ Attendance at sessions is suggested
☑️ Closed captioning will be provided on some audio or video recordings

All course material will be posted to OWL: [http://owl.uwo.ca](http://owl.uwo.ca). Any changes will be indicated on the OWL site and discussed with the class.

If students need assistance, they can seek support on the [OWL Help page](http://owl.uwo.ca). Alternatively, they can contact the [Western Technology Services Helpdesk](http://owl.uwo.ca). They can be contacted by phone at 519-661-3800 or ext. 83800.

Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click [here](http://owl.uwo.ca).

**NOTE:** In the event of a COVID-19 resurgence during the course that necessitates moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at times indicates in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online at the discretion of the instructor.

**3505F Part 1:** Fourier Transform Nuclear Magnetic Resonance  
**Instructor:** Dr. Neil Gelman  
**Lecture Dates:** Thursday Sept 9 to Tues Oct 19

The Fourier Transform is a powerful mathematical tool that has extensive applications in biophysics and medical physics. In particular, it forms the foundation for creating medical images and for analyzing the biomedical information provided by these images. In this section of the course we will introduce the one-dimensional Fourier Transform operation and its application in Magnetic Resonance Spectroscopy, a technique that is used to provide biochemical information in-vivo from humans and animals. We will also briefly consider how the one-dimensional Fourier Transform is applied to create a one-dimensional Magnetic Resonance Image. This section will provide a solid background for further courses involving medical imaging which often involve the application of two-dimensional and three-dimensional Fourier Transform operations.

**3505F Part 2:** Introduction to mathematical modeling in physiology and medicine  
**Instructor:** Dr. Keith St. Lawrence  
**Lecture Dates:** Thursday Oct 21 to Tuesday Dec 7

The objective is to understand linear system analysis and its application to modelling physiological processes. Topics will include predicting drug distribution and clearance from
the body, measuring tissue blood flow, and applications of simple feedback systems to
physiology. This section will include an introduction to linear systems, Laplace Transforms
and the convolution operator. We look forward to having you with us in 3305F.

The course consists of 24 lecture hours and 6 problem assignments.
To assist you in grasping the course material we have formal tutorial sessions (online-live),
during which you can consult with the tutorial leader and with each other while working on
the assignments or exercises. One section (002 LAB) is Wednesdays 2:30 to 4:30 pm, and
the other (003 LAB) is Thursdays 2:30 to 4:30. This means you have protected time for
consulting and doing much of the work, and you can count Biophysics 3305F as a laboratory
course.

We have always encouraged students to work together, but you take total responsibility for
what you submit to be marked. Note on Plagiarism: “Students must write their essays and
assignments in their own words. Whenever students take an idea, or a passage from another
author, they must acknowledge their debt both by using quotation marks where appropriate
and by proper referencing such as footnotes or citations. Plagiarism is a major academic
offence” (see Scholastic Offence Policy in the Western Academic Calendar).

There is no single text which suits us for most of the course. There is one computer
software package that you may wish to purchase: MATLAB student version. MATLAB
can be used online http://myvlab.uwo.ca/.

We wish to encourage you to contact us and discuss any problems arising from the
course, whether general or specific. We are always pleased to help. If you have any
concerns about the tutorial please contact Peter Jeon (yjeon4@uwo.ca) for part 1 or
Lucas Narciso (lnarciso@uwo.ca) for part 2.

5. Learning Outcomes

Upon successful completion of this course, students will be able to:
Knowledge
• Students will develop an understanding of Fourier and Laplace Transforms along with
related properties, which provide powerful mathematical tools in biomedical research
• Students will develop an understanding of the role of the Fourier transform in
magnetic resonance spectroscopy and magnetic resonance imaging
• Students will learn Laplace Transforms, systems analysis and their application to
physiology and medicine
• Students will develop an appreciation for the way in which magnetic resonance
spectroscopy can provide information about pathological changes in-vivo within
clinical and research area
• Students will develop an appreciation for the way in which mathematical modeling
can enhance our understanding of measuring how physiological processes are
regulated
Literacies and Interdisciplinarity
- Students will become comfortable with terminology utilized in signal analysis, particularly Fourier and Laplace analysis.
- Students will develop skill in applying the basic properties of the Fourier Transform to solving problems, such as related to extracting information from magnetic resonance spectroscopy signals.
- Students will develop the skills to apply linear systems analysis to physiological problems.
- Students will become familiar with utilizing symmetry properties to simplify problem solving. This will provide encouragement for use of symmetry properties in other mathematical scientific endeavours.
- Students will further develop written problem solving skills with special attention to solution organization and visualization (also relating to communication).

Communication
- Students will further develop their writing communication skills especially those pertain to communication of mathematical ideas in problem solving. This will occur through assignments, tutorials and in class problem solving sessions.

Critical Inquiring and Creative Thinking
- Students will have the opportunity to apply creative thinking in solving problems, especially those in which there are multiple pathways to solutions.

6. Course Content and Schedule

A schedule of topics for each lecture will be provided during the first class of each of the two parts of the course.

7. Participation and Engagement

✓ Students will find it helpful to participate and engage with content as much as possible.
✓ Students can also participate by interacting in the forums with their peers and instructors.
8. Evaluation

The final grade will be determined based on a 50% contribution from each of the two parts of the course (see “Course Syllabus” section above). The final mark will be obtained from problem assignments, one take home midterm test (Part 1 only) and an examination. The table below shows the mark breakdown for each part of the course, with a total of 100% for each part. The final mark will be the average of these two marks (each out of 100%). For each student the midterm test (part 1) will only count if it helps the student’s final mark. In other words, each student will receive a mark using either scheme A or scheme B, whichever gives the higher mark.

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<thead>
<tr>
<th></th>
<th>Course Part 1</th>
<th>Course Part 2</th>
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<tbody>
<tr>
<td></td>
<td>Scheme A</td>
<td>Scheme B</td>
</tr>
<tr>
<td>Assignments</td>
<td>40%</td>
<td>40%</td>
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<tr>
<td>Midterm test</td>
<td>20%</td>
<td>0%</td>
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<tr>
<td>Final Exam</td>
<td>40%</td>
<td>60%</td>
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Midterm Test: Tuesday Oct 19: remote test posted at 8 am, 24 hours to submit

Assignment Schedule

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Assignment Posted</th>
<th>Completed Assignments Submission Date</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>Sept 14</td>
<td>Sept 30</td>
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<tr>
<td>Assignment 2</td>
<td>Sept 28</td>
<td>Oct 12</td>
</tr>
<tr>
<td>Assignment 3</td>
<td>Oct 12</td>
<td>Oct 22</td>
</tr>
<tr>
<td>Assignment 4</td>
<td>Oct 26</td>
<td>Nov 9</td>
</tr>
<tr>
<td>Assignment 5</td>
<td>Nov 9</td>
<td>Nov 23</td>
</tr>
<tr>
<td>Assignment 6</td>
<td>Nov 24</td>
<td>Dec 2</td>
</tr>
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Communication:

☑️ Students should check the OWL site every 24 – 48 hours
☑️ Students should email their instructor(s) and teaching assistant(s) using [email]
☑️ Emails will be monitored daily; students will receive a response in 24 – 48 hours
☑️ Students can post course-related queries on the discussion forum so that everyone can access the questions and responses

9. Office Hours:

☑️ Office hours will be held [remotely using zoom]
☑️ Office hours can be arranged
10. Resources

☑ All resources will be posted in OWL

11. Professionalism & Privacy:

Western students are expected to follow the Student Code of Conduct. Additionally, the following expectations and professional conduct apply to this course:

☑ All course materials created by the instructor(s) are copyrighted and cannot be sold/shared
☑ Recordings are not permitted (audio or video) without explicit permission
☑ Permitted recordings are not to be distributed
☑ Students will be expected to take an academic integrity pledge before some assessments

12. How to Be Successful in this Class:

Students enrolled in this class should understand the level of autonomy and self-discipline required to be successful.

1. Invest in a planner or application to keep track of your courses. Populate all your deadlines at the start of the term and schedule time at the start of each week to get organized and manage your time.
2. Make it a daily habit to log onto OWL to ensure you have seen everything posted to help you succeed in this class.
3. Follow weekly checklists created on OWL or create your own to help you stay on track.
4. Take notes as you go through the lesson material. Keeping handwritten notes or even notes on a regular Word document will help you learn more effectively than just reading or watching the videos.
5. Connect with others. Try forming an online study group and try meeting on a weekly basis for study and peer support.
6. Do not be afraid to ask questions. If you are struggling with a topic, check the online discussion boards or contact your instructor(s) and or teaching assistant(s).
7. Reward yourself for successes. It seems easier to motivate ourselves knowing that there is something waiting for us at the end of the task.

13. Western Academic Policies and Statements

Absence from Course Commitments

Policy on Academic Consideration for Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. Approval can be granted either through a self-reported absence or via the Academic Counselling unit. Students have two self-reports to use throughout the academic year; absence from course commitments including tests, quizzes, presentations, labs, and assignments that are worth 30% or less can be self-reported. Self-reported absences cover a student for 48 hours (yesterday + today or today + tomorrow). Your instructor will receive notification of your consideration; however, you should contact your instructor immediately regarding your absence.
Students are expected to submit missed work within 24 hours of the end of the 48-hour period. Please review details of the university’s policy on academic consideration for student absences.

If you have used both their self-reported absences or will miss more than 48 hours of course requirements, a Student Medical Certificate (SMC) should be signed by a licensed medical or mental health practitioner and you should contact academic counselling. Academic Counselling will be operating virtually this year and can be contacted at scibmsac@uwo.ca.

**Accommodation for Religious Holidays**

The policy on Accommodation for Religious Holidays can be viewed [here](#).

**Special Examinations**

A Special Examination is any examination other than the regular examination, and it may be offered only with the permission of the Dean of the Faculty in which the student is registered, in consultation with the instructor and Department Chair. Permission to write a Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents. To provide an opportunity for students to recover from the circumstances resulting in a Special Examination, the University has implemented Special Examinations dates. These dates as well as other important information about examinations and academic standing can be found [here](#).

**Academic Offenses**

“Scholastic offences are taken seriously, and students are directed [here](#) to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence.

**Accessibility Statement**

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Accessible Education (AE) at 661-2111 x 82147 for any specific question regarding an accommodation or review The policy on Accommodation for Students with Disabilities.
Correspondence Statement

The centrally administered e-mail account provided to students will be considered the individual’s official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner. You can read about the privacy and security of the UWO email accounts here.

Discovery Credit Statement

Students are permitted to designate up to 1.0 Discovery Credit course (or equivalent) for pass/fail grading that can be counted toward the overall course credits required for their degree program. The details of this policy and the deadlines can be found here.

Essay Course Guidelines

The guidelines for the minimum written assignments refer to the cumulative amount of written work in a course but excludes written work in examinations. You can read about essay course guidelines here.

An essay course must normally involve total written assignments (essays or other appropriate prose composition, excluding examinations) as follows:

- Full course (1000 to 1999): at least 3000 words
- Half course (1000 to 1999): at least 1500 words
- Full course (2000 and above): at least 5000 words
- Half course (2000 and above): at least 2500 words

The structure of the essay course must be such that in order to pass the course, the student must exhibit some minimal level of competence in essay writing and the appropriate level of knowledge of the content of the course.

Turnitin and other similarity review software

All assignments will be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. Students will be able to view their results before the final submission. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between Western University and Turnitin.com.

14. BMSUE Academic Policies and Statements

Cell Phone and Electronic Device Policy (for in-person tests and exams)

The Schulich School of Medicine & Dentistry is committed to ensuring that testing and evaluation are undertaken fairly across all our departments and programs. For all tests and exams, it is the policy of the School that any electronic devices, i.e., cell phones, tablets, cameras, or iPod are strictly prohibited. These devices MUST be left either at home or with the student’s bag/jacket at the front of the room and MUST NOT be at the test/exam desk or in the individual's pocket. Any student found with one of these prohibited devices will receive a grade of zero on the test or exam. Non-programmable calculators are only allowed when indicated by the instructor. The program is not responsible for stolen/lost or broken devices.

Copyright and Audio/Video Recording Statement

Course material produced by faculty is copyrighted and to reproduce this material for any purposes other than your own educational use contravenes Canadian Copyright Laws. You must always ask permission to record another individual and you should never share or distribute recordings.
Rounding of Marks Statement

Across the Basic Medical Sciences Undergraduate Education programs, we strive to maintain high standards that reflect the effort that both students and faculty put into the teaching and learning experience during this course. All students will be treated equally and evaluated based only on their actual achievement. **Final grades** on this course, irrespective of the number of decimal places used in marking individual assignments and tests, will be calculated to one decimal place and rounded to the nearest integer, e.g., 74.4 becomes 74, and 74.5 becomes 75. Marks WILL NOT be bumped to the next grade or GPA, e.g. a 79 will NOT be bumped up to an 80, an 84 WILL NOT be bumped up to an 85, etc. The mark attained is the mark you achieved, and the mark assigned; requests for mark “bumping” will be denied.

15. Support Services

The following links provide information about support services at Western University.

- Academic Counselling (Science and Basic Medical Sciences)
- Appeal Procedures
- Registrarial Services
- Student Development Services
- Student Health Services