Medical Biophysics / Biomedical Engineering

Introduction to Medical Imaging
MEDBIO 4475A, BIOPHYS 9515, and BME 9513

Course outline for Fall 2020

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 wellbeing. 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

2. Important Dates:
   - **Delivery Mode** | **Dates** | **Time**
   - online | Monday | 3:30 – 5:30 p.m.
   - online | Friday | 9:30 – 10:30 a.m.

   *Details about design and delivery of the course are listed below in Section 4
   ** The times listed above represent the scheduled class hours, at which synchronous sessions may occur

   - **First Class** | **Reading Week** | **Last Class** | **Study day(s)** | **Exam Period**
   - September 11 | November 2 - 8 | December 7 | December 10 | December 11 - 22

   * November 12, 2020: Last day to drop a first-term half course or a first-term full course without penalty

3. Contact Information

   - **Course Coordinator** | **Contact Information**
     - Maria Drangova | mdrangova@robarts.ca

   - **Instructors** | **Contact Information**
     - Maria Drangova | mdrangova@robarts.ca
     - James Lacefield | jlacefie@uwo.ca
     - Ian Cunningham | icunningham@robarts.ca
     - Keith St. Lawrence | kstlaw@lawsonimaging.ca
     - David Holdsworth | dholdsworth@robarts.ca

   - **Teaching Assistant** | **Contact Information**
     - Mahsa Bataghva | mbataghv@uwo.ca
4. Course Description and Design

Through this introductory course the student will learn the physics and methods of how medical images are formed. By the end of the term the student will understand how images are formed for the following different imaging modalities: ultrasound, x-rays, computed tomography, nuclear medicine, positron-emission tomography, and magnetic resonance imaging. To understand the tomographic imaging modalities, the student will also gain knowledge of the Fourier Transform and its applications in medical imaging. A basic understanding of the sources of noise and artifacts in the different modalities will also be attained, along with an understanding of the limits to the achievable resolution.

The official course description can be found in the Academic Calendar.

Prerequisite(s):
- (Medical Biophysics 3503G or the former Med Bio 3302E); or
- (Medical Biophysics 3505F and 3507G), or the former Med Bio 3303E; and
  1.0 course from (Med Bio 2128A/B and 2129A/B), or (Physics 2128A/B and 2129A/B, or Physics 2101A/B and 2102A/B), or
- Permission of the department.

This course will be delivered completely online. Virtual sessions will be a combination of synchronous (live) and asynchronous (recorded). Students will be expected to complete work prior to attending synchronous sessions. Timetabled sessions could be used for lectures, tutorials, discussions, etc.

As the course covers six distinct areas, each with a different instructor, the time allocated to synchronous and asynchronous hours may vary between instructors.

The details below are tentative

<table>
<thead>
<tr>
<th>Mode</th>
<th>Dates</th>
<th>Time</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual synchronous*</td>
<td>M</td>
<td>4 – 5 p.m. (tentative; check calendar)</td>
<td>weekly**</td>
</tr>
<tr>
<td>Virtual asynchronous</td>
<td>N/A</td>
<td>approximately 100 min.</td>
<td>weekly</td>
</tr>
</tbody>
</table>

* Synchronous hours will be selected from the following times: Monday 3:30 to 5:30 and Friday 9:30 to 10:30 or another time that is suitable to the instructor and the majority of the class

☑ Attendance at synchronous sessions is encouraged
☑ A recording will be provided for synchronous sessions; see notice of recording
☑ Closed captioning will be provided on 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://westerntechservices.uwo.ca). They can be contacted by phone at 519-661-3800 or ext. 83800.

[Google Chrome](http://google.com) or [Mozilla Firefox](http://mozilla.com) are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click [here](http://speedtest.net).
5. **Learning Outcomes**

Upon successful completion of this course, students will be able to:

- Describe the foundational physics and underlying methods used to generate medical images based on ultrasound, x-rays, computed tomography, nuclear medicine methods, positron-emission tomography, and magnetic resonance imaging.
- Understand the underlying principles for tomographic imaging modalities, including how to manipulate and use the Fourier Transform and how it is used in applications in medical imaging.
- Identify the sources of noise and artifacts in the different imaging modalities discussed.
- Understand the fundamental limits for each of the imaging methods with respect to spatial and temporal resolution.

6. **Course Content and Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topic</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sept 9 – 13</td>
<td>Ultrasound</td>
<td>Lacefield</td>
</tr>
<tr>
<td>2</td>
<td>Sept 14 – 20</td>
<td>Ultrasound</td>
<td>Lacefield</td>
</tr>
<tr>
<td>3</td>
<td>Sept 21 – 27</td>
<td>Ultrasound / Fourier</td>
<td>Lacefield/ St. Lawrence</td>
</tr>
<tr>
<td>4</td>
<td>Sept 28 – Oct 4</td>
<td>Fourier Transforms</td>
<td>St. Lawrence</td>
</tr>
<tr>
<td>5</td>
<td>Oct 5 – 11</td>
<td>Diagnostic Radiography</td>
<td>Cunningham</td>
</tr>
<tr>
<td>6</td>
<td>Oct 12 – 18</td>
<td>Diagnostic Radiography</td>
<td>Cunningham</td>
</tr>
<tr>
<td>7</td>
<td>Oct 19 – 25</td>
<td>Diagnostic Radiography / MRI</td>
<td>Cunningham/ Drangova</td>
</tr>
<tr>
<td>8</td>
<td>Oct 26 – Nov 1</td>
<td>Midterm / MRI</td>
<td>Drangova</td>
</tr>
<tr>
<td>9</td>
<td>Nov 2 – 8</td>
<td>Reading Week</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>Nov 9 – 15</td>
<td>MRI</td>
<td>Drangova</td>
</tr>
<tr>
<td>11</td>
<td>Nov 16 – 22</td>
<td>Computed Tomography (CT)</td>
<td>Holdsworth</td>
</tr>
<tr>
<td>12</td>
<td>Nov 23 – 29</td>
<td>CT / Nuclear Medicine</td>
<td>Holdsworth</td>
</tr>
<tr>
<td>13</td>
<td>Nov 30 – Dec 6</td>
<td>Nuclear Medicine / PET</td>
<td>Holdsworth</td>
</tr>
<tr>
<td>14</td>
<td>Dec 7 – 9</td>
<td>Positron Emission Tomography</td>
<td>Holdsworth</td>
</tr>
</tbody>
</table>

7. **Online Participation and Engagement**

- Students are expected to participate and engage with content as much as possible.
- Students are encouraged to participate during synchronous sessions.
- Students can also participate by interacting in the forums with their peers and instructors.
Below is the evaluation breakdown for the course. Any deviations will be communicated.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Format</th>
<th>Weighting</th>
<th>Tentative Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignments</td>
<td>Problem solutions</td>
<td>40% (split equally between the assignments)</td>
<td>One week after assignment is handed out by the end of the day.</td>
</tr>
<tr>
<td>Midterm*</td>
<td>At home, set time, mixed question format</td>
<td>30%</td>
<td>Monday October 26 3:30 p.m. to 8:30 p.m.</td>
</tr>
<tr>
<td>Final exam*</td>
<td>At home, set time, mixed question format</td>
<td>30%</td>
<td>Date TBA; 5 hours allotted</td>
</tr>
</tbody>
</table>

* The midterm and final exams can be completed in less than 3 hours. Five hours will be allowed to accommodate for additional time required for on-line submission etc.

- All assignments are due by 11:55 pm EST unless otherwise specified
- Whenever appropriate for the assessment, written assignments will be submitted to Turnitin (statement in policies below); Students will have unlimited submissions to Turnitin
- After an assessment is returned, students should wait 24 hours to digest feedback before contacting their evaluator; to ensure a timely response, reach out within 7 days

Click [here](#) for a detailed and comprehensive set of policies and regulations concerning examinations and grading. The table below outlines the University-wide grade descriptors.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>90-100</td>
<td>One could scarcely expect better from a student at this level</td>
</tr>
<tr>
<td>A</td>
<td>80-89</td>
<td>Superior work which is clearly above average</td>
</tr>
<tr>
<td>B</td>
<td>70-79</td>
<td>Good work, meeting all requirements, and eminently satisfactory</td>
</tr>
<tr>
<td>C</td>
<td>60-69</td>
<td>Competent work, meeting requirements</td>
</tr>
<tr>
<td>D</td>
<td>50-59</td>
<td>Fair work, minimally acceptable</td>
</tr>
<tr>
<td>F</td>
<td>below 50</td>
<td>Fail</td>
</tr>
</tbody>
</table>

Information about late or missed evaluations:
- Late assessments without self-reported absences will be subject to a late penalty of 10%/day
- Late assessments with self-reported absences should be submitted within 24 hours of the end of the 48-hour period.
- An assignment cannot be submitted after it has been returned to the class; the weight will be transferred to the midterm or exam depending on which assignment is missed.
- A make-up test will be offered for tests missed with self-reported absences; contact the coordinator
- If a make-up test is missed, the student will receive an INC and complete the task the next time the course is offered
9. **Communication:**
- Students should check the OWL site every 24 – 48 hours
- Students should email their instructor(s) and teaching assistant(s) using OWL “messages” unless indicated otherwise by the instructor
- Emails will be monitored daily; students will receive a response in 24 – 48 hours
- This course will use Zoom for synchronous sessions
- This course will use the OWL forum for discussions
- Students should post all course-related content on the discussion forum so that everyone can access answers to questions
- The discussion forums will be monitored daily by instructors and/ or teaching assistant

10. **Office Hours:**
- Schedule help sessions with instructors/ TA as needed; Zoom will be used for help sessions
- The synchronous sessions will act as group office hours; they will be recorded and posted for everyone to view

11. **Resources**
- All resources will be posted in OWL
- Required textbook – there is no required textbook for the course. Notes will be posted, along with suggestions for additional reading material

12. **Professionalism & Privacy:**
Western students are expected to follow the [Student Code of Conduct](#). Additionally, the following expectations and professional conduct apply to this course:
- Students are expected to follow online etiquette expectations provided on OWL
- 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
- All recorded sessions will remain within the course site or unlisted if streamed

13. **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 checklists created on OWL or create your own to help you stay on track.
4. Take notes as you go through the lesson material. Treat this course as you would a face-to-face course. 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.

14. 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 your 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.

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.

15. BMSUE Academic Policies and Statements

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.

16. 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