Course Outline (W2019)

BME872: Biomedical Image Analysis

**Instructor(s)**
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Email: javad@ryerson.ca
Office Hours: TBA

**Calendar Description**
Introduces the fundamental principles of medical image analysis and visualization. Focuses on the processing and analysis of ultrasound, MR, and X-ray images for the purpose of quantification and visualization to increase the usefulness of modern medical image data. Includes image perception and enhancement, 2-D Fourier transform, spatial filters, segmentation, and pattern recognition.

**Prerequisites**
BME 229 and BME 772

**Antirequisites**
None

**Corerequisites**
None

**Compulsory Text(s):**

**Reference Text(s):**

**Learning Objectives (Indicators)**
At the end of this course, the successful student will be able to:

1. Students will learn to use Complex numbers, Fourier Transform, Z-Transform to model and describe the imaging systems. (1b)
2. Students will learn different imaging techniques that are commonly used to acquire biomedical images (1c)
3. Students are able to use their engineering knowledge to depict the System Input output relationship. (1d)
4. Students will learn methods for contrast enhancement and improvement of the visibility of the details of interest in medical images (2a)
5. Students will measure image quality and information concept obtained from different medical equipment such as MR, CT, ultrasound and X-ray (3a)
6. Students will be able to process, manipulate the data which are obtained from different medical imaging devices. (3b)
7. Students will learn methods for the characterization and removal of the artifacts and noise from acquired medical images. (4a)
8. Students will learn pattern analysis and pattern classification techniques for diagnostic decision. (4b)
9. Students will design and develop segmentation techniques to detect region of interest and extract the region of interest for medical diagnosis and clinical assessment. (5a)
10. Students will implement image processing techniques to improve the general quality of the desired features in medical images. (5b)
11. Students will research on currently used medical equipment in hospitals. They will identify needs and place of improvement for new generation of medical devices. (8b)
12. Students will learn how to manage their course project. Students will understand the important aspects of the project management, such as time-line, progress report, final delivery of the product, and the deadlines. (11b)

**NOTE:** Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).

**Course Organization**
3.0 hours of lecture per week for 13 weeks
2.0 hours of lab/tutorial per week for 12 weeks

**Teaching Assistants**
TBA
**Course Evaluation**

Course evaluation not set for course.

**Note:** In order for a student to pass a course with “Theory and Laboratory” components, in addition to earning a minimum overall course mark of 50%, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the "Course Evaluation" section for details on the Theory and Laboratory components.

**Examinations**

Midterm in Week 6, two hours, closed-book (covers Weeks 1-6). 20% of the final mark.  
Final exam, during exam period, three hours, closed-book, formula sheet will be provided. 40% of the final mark.

**Other Evaluation Information**

Lab reports 20% of the final mark.
Course project 20% of the final mark.  
- Each project combines two separate components: a written component, and an oral component. It is an individual project, marks will be awarded out of 20 as per the following schedule:
  - Final project written report. Week 12. (10 Marks)  
  - Final project oral presentation. Week 12, 13. (10 Marks)

**Other Information**

None

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**Course Content**

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<td>Experiment 5: Medical Image Segmentation using region growing and splitting</td>
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Policies & Important Information:

1. Students are required to obtain and maintain a Ryerson e-mail account for timely communications between the instructor and the students;
2. Any changes in the course outline, test dates, marking or evaluation will be discussed in class prior to being implemented;
3. Assignments, projects, reports and other deadline-bound course assessment components handed in past the due date will receive a mark of ZERO, unless otherwise stated. Marking information will be made available at the time when such course assessment components are announced.
4. Refer to our Departmental FAQ page for information on common questions and issues at the following link: [https://www.ee.ryerson.ca/guides/Student.Academic.FAQ.html](https://www.ee.ryerson.ca/guides/Student.Academic.FAQ.html).

Missed Classes and/or Evaluations

When possible, students are required to inform their instructors of any situation which arises during the semester which may have an adverse effect upon their academic performance, and must request any consideration and accommodation according to the relevant policies as far in advance as possible. Failure to do so may jeopardize any academic appeals.

1. **Health certificates** - If a student misses the deadline for submitting an assignment, or the date of an exam or other evaluation component for health reasons, they should notify their instructor as soon as possible, and submit a Ryerson Student Health Certificate AND an Academic Consideration Request form within 3 working days of the missed date. Both documents are available at [https://www.ryerson.ca/senate/forms/medical.pdf](https://www.ryerson.ca/senate/forms/medical.pdf). If you are a full-time or part-time degree student, then you submit your forms to your own program department or school;
2. **Religious, Aboriginal and Spiritual observance** - If a student needs accommodation because of religious, Aboriginal or spiritual observance, they must submit a Request for Accommodation of Student Religious, Aboriginal and Spiritual Observance AND an Academic Consideration Request form within the first 2 weeks of the class or, for a final examination, within 2 weeks of the posting of the examination schedule. If the requested absence occurs within the first 2 weeks of classes, or the dates are not known well in advance as they are linked to other conditions, these forms should be submitted with as much lead time as possible in advance of the absence. Both documents are available at [www.ryerson.ca/senate/forms/relobservforminstr.pdf](http://www.ryerson.ca/senate/forms/relobservforminstr.pdf). If you are a full-time or part-time degree student, then you submit the forms to your own program department or school;
3. **Academic Accommodation Support** - Before the first graded work is due, students registered with the Academic Accommodation Support office (AAS - [www.ryerson.ca/studentlearningsupport/academic-accommodation-support](http://www.ryerson.ca/studentlearningsupport/academic-accommodation-support)) should provide their instructors with an Academic Accommodation letter that describes their academic accommodation plan.

Academic Integrity
Ryerson's Policy 60 (the Academic Integrity policy) applies to all students at the University. Forms of academic misconduct include plagiarism, cheating, supplying false information to the University, and other acts. The most common form of academic misconduct is plagiarism - a serious academic offence, with potentially severe penalties and other consequences. It is expected, therefore, that all examinations and work submitted for evaluation and course credit will be the product of each student's individual effort (or an authorized group of students). Submitting the same work for credit to more than one course, without instructor approval, can also be considered a form of plagiarism.

Suspicions of academic misconduct may be referred to the Academic Integrity Office (AIO). Students who are found to have committed academic misconduct will have a Disciplinary Notation (DN) placed on their academic record (not on their transcript) and will normally be assigned one or more of the following penalties:

1. A grade reduction for the work, ranging up to an including a zero on the work (minimum penalty for graduate work is a zero on the work);
2. A grade reduction in the course greater than a zero on the work. (Note that this penalty can only be applied to course components worth 10% or less, and any additional penalty cannot exceed 10% of the final course grade. Students must be given prior notice that such a penalty will be assigned (e.g. in the course outline or on the assignment handout);
3. An F in the course;
4. More serious penalties up to and including expulsion from the University.

The unauthorized use of intellectual property of others, including your professor, for distribution, sale, or profit is expressly prohibited, in accordance with Policy 60 (Sections 2.8 and 2.10). Intellectual property includes, but is not limited to:

1. Slides
2. Lecture notes
3. Presentation materials used in and outside of class
4. Lab manuals
5. Course packs
6. Exams

For more detailed information on these issues, please refer to the Academic Integrity policy (https://www.ryerson.ca/senate/policies/pol60.pdf) and to the Academic Integrity Office website (https://www.ryerson.ca/academicintegrity/).

Important Resources Available at Ryerson

1. The Library (https://library.ryerson.ca/) provides research workshops and individual assistance. Inquire at the Reference Desk on the second floor of the library, or go to library.ryerson.ca/guides/workshops
2. Student Learning Support (https://www.ryerson.ca/studentlearningsupport) offers group-based and individual help with writing, math, study skills and transition support, and other issues.