Course Outline (W2020)

BME632: Signals and Systems II

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

Calendar Description
The topics covered in the course includes a general discussion on discrete signals (periodic signals, unit step, impulse, complex exponential), a general discussion on discrete systems, Discrete-Time Fourier Series (DTFS), Discrete-Time Fourier Transform (DTFT); analysis and synthesis, Fourier Spectra; continuous nature, periodicity, existence, Properties of the DTFT; linearity, conjugation, time/frequency reversal, time/frequency shifting, etc. LTI discrete time system analysis using DTFT, DTFT and Continuous-Time FT comparison and relation, DFT and FFT discussion and their relation to DTFT and CTFT, Discrete-Time Sampling, Z-Transform; generalization of the DTFT.

Prerequisites
BME 532, CEN 199

Antirequisites
ELE 632

Corequisites
None

Compulsory Text(s):

Reference Text(s):
At the end of this course, the successful student will be able to:

1. Describe differences between different evaluation methods and select and apply appropriate evaluation methods. Describe differences between methods, and use specific methods in hypothetical design situations. More specifically: learn frequency analysis of discrete-time signals and LTI systems and describe differences between Fourier transform and Fourier series analysis. Perform both Fourier transform and Fourier series in hypothetical design and analysis of signals and LTI systems (4b)
2. Collect and analyze biomedical signals using a signal acquisition system and Matlab. Ensure signals are correctly acquired through visual and automated analysis, investigate physiological behaviour of signals, quantify performance of algorithms through various metrics in Matlab. (5b)
3. Read and appropriately respond to technical and non-technical written instructions. Cites evidence to construct and support an argument. Produce four lab reports using appropriate format, grammar, and citation styles for technical and non-technical audiences. (7a)
4. Emphasis on bridging the medical and engineering uses of biomedical signals. Creating technologies that can make the job of the physician more accurate and efficient. (9b)
5. Ensure that data is collected and stored anonymously. (10a)
6. Students are referred to textbook, lab manual and other material to ensure labs and lecture material are learned. (12a)

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

<table>
<thead>
<tr>
<th>Theory: Midterm Exam</th>
<th>25 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory: Quizzes (5 x 3%)</td>
<td>15 %</td>
</tr>
<tr>
<td>Theory: Final Exam</td>
<td>40 %</td>
</tr>
<tr>
<td>Laboratory: Assignments (4 x 5%)</td>
<td>20 %</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>100 %</td>
</tr>
</tbody>
</table>

**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 exam is scheduled for the week of February 24, 2020. Exact date and details to come.

### Other Evaluation Information

**Note:** Students must achieve passing grades in both the lecture AND the laboratory components of the course, separately, in order to pass the course.

### Other Information

**Practice Problems**

Practice problems and their solutions will be provided on the course web page. These assignments will neither be collected nor graded; they are provided only as a study guide. You are strongly recommended to attempt to solve the problems on your own without looking at the solutions first. If you have any question about an assignment problem or its respective solution, please consult the course instructor or the teaching assistant during their consulting hours.

Lab experiments are to be done in partners and the write-ups are handed in during the 2nd part of the schedule lab time as indicated on the course content schedule. The assignments will be made available on the course web. Due dates and instructions will be posted on the web site also. It is your responsibility to check these and download and submit your assignments online by the deadlines.

### Course Content

<table>
<thead>
<tr>
<th>Week</th>
<th>Hours</th>
<th>Chapters / Section</th>
<th>Topic, description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>Chapter 3 Sections 1-3</td>
<td>Introduction to discrete-time systems and signals.</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Chapter 3 Sections 3-4</td>
<td>Time domain analysis of discrete time systems useful discrete-time signals.</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Chapter 3 Sections 4-5</td>
<td>Classification of discrete systems discrete system equations system response to internal conditions.</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>Chapter 3 Sections 6-7</td>
<td>Unit impulse response system response BIBO stability criterion.</td>
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<tr>
<td></td>
<td></td>
<td>Chapter/Sections</td>
<td>Description</td>
</tr>
<tr>
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<tr>
<td>5</td>
<td>3</td>
<td>Chapter 3 Sections 8-10</td>
<td>Convolution and its properties LTI systems and impulse response.</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td></td>
<td>Midterm Exam</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>Chapter 5 Sections 1-4</td>
<td>Fourier analysis of discrete systems DTFS periodic and aperiodic signal representation.</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>Chapter 5 Sections 5,8,9</td>
<td>Properties of DTFT system analysis using DTFT digital filters.</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>Chapter 8 Sections 1-4</td>
<td>Sampling theorem signal reconstruction.</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>Chapter 8 Sections 5,6</td>
<td>Spectral Sampling DFT properties and applications FFT.</td>
</tr>
<tr>
<td>11</td>
<td>3</td>
<td>Chapter 9 Sections 1-2</td>
<td>z-Transform properties inverse transform solution to difference equations.</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>Chapter 9 Sections 3-4</td>
<td>z-Transform system realization frequency response of discrete systems pole-zero analysis stability.</td>
</tr>
<tr>
<td>13</td>
<td>3</td>
<td>Chapter 9 Sections 5,6</td>
<td>DTFT connection with CTFT DTFT and z-Transform.</td>
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</tbody>
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### Laboratory/Tutorials/Activity Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lab</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>NO LABS or Quizzes</td>
</tr>
<tr>
<td>2-3</td>
<td>LAB 1</td>
<td>Lab 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Demo and report due by end of final lab session</td>
</tr>
<tr>
<td>3</td>
<td>QUIZ 1</td>
<td>Quiz 1</td>
</tr>
<tr>
<td>4-6</td>
<td>LAB 2</td>
<td>Lab 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Demo and report due by end of final lab session</td>
</tr>
</tbody>
</table>
5 | QUIZ 2 | Quiz 2
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8-10 | LAB 3 | Lab 3
* Demo and report due by end of final lab session
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8 | QUIZ 3 | Quiz 3
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10-11 | LAB 4 | Lab 4
* Demo and report due by end of final lab session
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10 | QUIZ 4 | Quiz 4
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12 | QUIZ 5 | Quiz 5

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](https://www.ryerson.ca/guides/Student.Academic.FAQ.html) page for information on common questions and issues at the following link:

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](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 [Policies 60 (the Academic Integrity policy)](http://www.ryerson.ca/studentlearningsupport/academic-accommodation-support) 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.