1 Course Details

1.1 Calendar Description

This course develops a comprehensive understanding of methods and analysis related to research in biomechanics & neuroscience. Critical evaluation and application of basic signal to noise processing and electromyography is a priority. The course uses labs, assignments, and critical review of primary literature articles to develop a strong research foundation. Scientific writing and oral communication skills are emphasized via written reports and presentations, and numeracy throughout the course in data and lab assignments.

1.2 Course Description

This course develops a comprehensive understanding of methods and analysis related to research in biomechanics & neuroscience. The course uses labs, assignments, and critical review of primary literature articles to develop a strong research foundation. Critical evaluation and application of research methods is a priority. Scientific writing and oral communication skills are emphasized via written reports and presentations, and numeracy throughout the course in data and lab assignments.

1.3 Timetable

Lecture Schedule: Friday 9:00 am - 12:50 pm; SSC1304 (likely in person with a possible remote option)

Lab Schedule: Mondays 9:00 am - 12:00 pm; possible in person and remote hybrid. This time period must be reserved.
Office hours: Set up via email for Teams and/or Zoom appointments.

1.4 Final Exam

time and place t.b.a.

2 Instructional Support

2.1 Instructional Support Team

<table>
<thead>
<tr>
<th>Instructor:</th>
<th>Lori Ann Vallis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email:</td>
<td><a href="mailto:lvallis@uoguelph.ca">lvallis@uoguelph.ca</a></td>
</tr>
<tr>
<td>Telephone:</td>
<td>+1-519-824-4120 x54589</td>
</tr>
<tr>
<td>Office:</td>
<td>ANNU 343</td>
</tr>
<tr>
<td>Office Hours:</td>
<td>by appointment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructor:</th>
<th>Steve Brown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email:</td>
<td><a href="mailto:shmbrown@uoguelph.ca">shmbrown@uoguelph.ca</a></td>
</tr>
<tr>
<td>Office Hours:</td>
<td>by appointment</td>
</tr>
</tbody>
</table>

3 Learning Resources

3.1 Recommended Resources

Resources (Article)

Guidelines to Help Focus Reading of Scientific Papers

The following are some guidelines to keep in mind while reading scientific publications.

1. What was the reason for doing the work in the first place?
2. Was the question posed in a researchable way?
3. What was being measured?
4. Was the measure appropriate to answer #1?
5. How was it measured?
6. Was the measurement technique suitable?
7. Were there any assumptions or errors (implicit or explicit) that might nullify any conclusions drawn?
8. What were the main useful facts and findings?
9. What did the author(s) conclude?
10. Were the finding/data unequivocal? Were/are there other equally valid interpretations?
11. How would you have approached the research problem?

**Suggested General Readings**


**Bio-instrumentation Section:**


**Numerical Methods Section:**


This is an informative and detailed text. The material is intended to reinforce the concepts that are covered in class. Accordingly, only certain sections are pertinent. For example, Chapter 1: pages 1-3 DSP intro
- **Chapter 2:** pseudocode representation of algorithms, S, time domain, pdf, cumulative pdf, precision/accuracy.
- **Chapter 3:** quantitization and sampling theorem apply to Bioinstrumentation section.
- **Chapter 4:** general concepts from pages 67-76.
- **Chapter 5:** to page 100 & Fourier decomposition pg. 104.
- **Chapter 8:** Discrete Fourier Transform
- **Chapter 14:** Digital Filters etc.


**Electromyography Section**


4 Learning Outcomes

The goals of these courses (Research Methods in Integrative Biomechanics and Neurophysiology I & II) are to build critical analysis and application of biomechanics and neuroscience related research methods and analysis, as well as to develop numeracy along with scientific writing and oral presentation skills. The overarching philosophy is to establish research competency by developing tenants of scientific inquiry: critical evaluation and application of research methods and effective scientific writing and presentation; all done in the context of the scientific method. The course begins with establishing a foundation in the principles of signal analysis, and then proceeds to apply these concepts in evaluation and application of research methodologies. These methodologies in of themselves are studied in-depth, and span across the related research dimensions to provide a comprehensive basis in understanding biomechanics & neuroscience inquiry.

The courses have continual and multidimensional assessment. Evaluation will be provided in an ongoing basis for in-lab work, reports, assignments, presentations, and examinations. Labs, lab reports, oral presentations and assignments allow for assessment of the translation of concepts to applications, proficiency in numeracy, as well as written and oral communication skills. The examinations evaluate conceptual understanding and critical evaluation of material. Peer evaluation of written assignments and presentations offer an additional dimension of assessment. Numeracy is developed in both conceptual and applied dimensions. Conceptual underpinnings are provided in lecture material for signal analysis, numerical data methods and programming. Applied numeracy is achieved via analysis of lab data, data processing assignments, and introduction to programming as related to numerical analysis.
Written communication skills will be developed in consideration of logical, concise, and in-depth scientific writing; stylistic aspects will be emphasized in relaying information clearly and in an organized manner. Logic in scientific writing will be developed by 1) critical analysis of primary literature articles, focusing on the scientific method aspects of establishing the research question and hypotheses, the efficacy of methods applied in addressing the scientific question, the interpretation and conclusions drawn from the results, 2) written lab reports based on exploration of analytical techniques, building upon concepts presented and discussed in lecture, 3) development of an individual research proposal, complete with establishing purpose, hypotheses, methods, along with preliminary analysis of data. Stylistic writing skills will be emphasized throughout the course: all written work will be placed in the context of clear and concise writing. Stylistic feedback on initial submissions of written reports will be provided (via instructor and peers) for follow-up self-evaluation and revision of writing approach. Evaluation of primary literature articles will involve appraisal of grammar and style. Peer assessment will include reflection on one’s own writing in the context of considering other’s writing styles.

Oral communication skills will be developed in a number of ways. In all cases, the emphasis will be placed upon effectively communicating the material of the presentation. Formal oral presentations will be done in 1) the critical analysis of primary literature article, 2) the research proposal and initial results (both as mentioned above). Presentations will be evaluated by peers, and ensuing discussions and questions student-led. Moreover, lectures are designed in an active learning approach, via interactive discussion of concepts. Interpersonal communication will be developed via work in lab and assignment groups.

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

4.1 Course Learning Outcomes

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

1. Critically evaluate primary literature, particularly in the context of methods and analysis techniques
2. Understand and apply numerical analyses, including via mathematical programming
3. Effectively communicate via formal writing, with an emphasis on scientific writing
4. Effectively communicate via oral presentation
5. Work well with peers to meet learning goals through collaboration

5 Teaching and Learning Activities

5.1 Lecture schedule
<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic (Fri)</th>
<th>Date</th>
<th>Assignment/Lab (Mon)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept 10 (Steve)</td>
<td>Overview of Course, Transducers and Signals</td>
<td>Sept 13</td>
<td></td>
</tr>
<tr>
<td>Sept 17 (Steve)</td>
<td>Fourier analysis, Mechanical systems, Filtering</td>
<td>Sept 20</td>
<td></td>
</tr>
<tr>
<td>Sept 24 (Steve)</td>
<td>Filtering continued, Differentiation and Integration</td>
<td>Sept 27</td>
<td>Lab 1: Digital Sampling, Filtering</td>
</tr>
<tr>
<td>Oct 1 (Steve)</td>
<td>Linear systems, Modeling</td>
<td>Oct 4 (Steve)</td>
<td>Assignment: Filtering, differentiation, integration, Lab 1 due</td>
</tr>
<tr>
<td>Oct 8 (Steve)</td>
<td>Review Session</td>
<td>Oct 11</td>
<td>Thanksgiving Holiday</td>
</tr>
<tr>
<td>Oct 15</td>
<td><strong>Midterm Exam</strong></td>
<td>Oct 18</td>
<td></td>
</tr>
<tr>
<td>Oct 22 (Lori)</td>
<td>EMG 1 (X-bridge theory; recruitment; instrumentation; vel-force relationships)</td>
<td>Oct 25 (Lori)</td>
<td></td>
</tr>
<tr>
<td>Oct 29</td>
<td>EMG 2</td>
<td>Nov 1</td>
<td>Lab 2: Administered Virtually</td>
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<td>---------</td>
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<td>---------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>(Lori)</td>
<td>(Force &amp; fatigue relationship; EMG analysis techniques)</td>
<td>(Lori)</td>
<td>Surface &amp; Indwelling EMG of FDI muscle</td>
</tr>
<tr>
<td>Nov 5</td>
<td>EMG 3</td>
<td>Nov 8</td>
<td></td>
</tr>
<tr>
<td>(Lori)</td>
<td>Finish fatigue concepts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov 12</td>
<td>Numerical Methods 2</td>
<td>Nov 15</td>
<td>Summary Paragraph for Fatigue paper Due to Lori</td>
</tr>
<tr>
<td>(Lori)</td>
<td>(Correlations; spike triggered avg)</td>
<td></td>
<td></td>
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<tr>
<td>Nov 19</td>
<td>Presentations Fatigue paper</td>
<td>Nov 22</td>
<td>Review Session</td>
</tr>
<tr>
<td>(Lori)</td>
<td></td>
<td>(Lori)</td>
<td></td>
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<tr>
<td>Nov 26</td>
<td>Final Exam</td>
<td></td>
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</tr>
</tbody>
</table>

### 6 Assessments

#### 6.1 ASSESSMENT

<table>
<thead>
<tr>
<th>Weight of Assessment</th>
<th>Activity</th>
<th>Learning Outcome Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>Assignment (Dr. Brown)</td>
<td>1, 2, 5</td>
</tr>
<tr>
<td>30%</td>
<td>2 Laboratory Reports (15% each)</td>
<td>1, 2, 3, 5</td>
</tr>
<tr>
<td>20%</td>
<td>Oral Presentation of Research Article/Proposal (Dr.Vallis)</td>
<td>1, 4</td>
</tr>
<tr>
<td>20%</td>
<td>Midterm I Exam: Content from Dr. Brown's 2,3 section</td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>Midterm II Exam: Content from Dr. Vallis' 2, 3 section</td>
<td></td>
</tr>
</tbody>
</table>
6.2 IMPORTANT DATES

Laboratory Report (Bioinstrumentation, Dr. Brown): Due October 4th

Assignment (Dr. Brown): Due October 8th

Midterm I (Dr. Brown): October 15th

Fatigue presentation (Dr. Vallis): Choose paper by November 5th (email Lori), Paper summary due November 15th, Final presentation November 19th

Laboratory Report 2 (EMG, Dr. Vallis): Due November 11th

Midterm II (Dr. Vallis): November 26th

7 Department of Human Health and Nutritional Sciences

Statements

7.1 Academic Advisors

If you are concerned about any aspect of your academic program:

• Make an appointment with a program counsellor in your degree program. B.Sc. Academic Advising or Program Counsellors

7.2 Academic Support

If you are struggling to succeed academically:

• Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist. http://www.learningcommons.uoguelph.ca/

• Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: http://www.lib.uoguelph.ca/get-
assistance/studying/chemistry-physics-help and http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help

7.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance. https://www.uoguelph.ca/counselling/
- Student Health Services is located on campus and is available to provide medical attention. https://www.uoguelph.ca/studenthealthservices/clinic
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. http://www.selfregulationskills.ca/

7.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) http://www.e-laws.gov.on.ca/index.html. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar. (https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml)

7.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

8 University Statements

8.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.
8.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

8.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

8.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

8.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is
required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website https://www.ridgetownc.com/services/accessibilityservices.cfm

8.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

8.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

8.8 Resources

The Academic Calendars are the source of information about the University of Guelph’s procedures, policies, and regulations that apply to undergraduate, graduate, and diploma
programs.

Academic Calendars
https://www.uoguelph.ca/academics/calendars

8.9 Disclaimer
Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

8.10 Illness
Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

8.11 Covid-19 Safety Protocols
For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.