Neuromuscular Integration of Human Movement

Instructor: Dr. J. Timothy Inglis
Phone: 604 822-1626
Office: Room 218
War Memorial Gym
Email: tim.inglis@ubc.ca

Teaching Assistants:
Taylor Cleworth: t.cleworth@alumni.ubc.ca
Robyn Mildren: robyn.mildren@alumni.ubc.ca

Location and Time:
2. Labs: Tues: 10:00-12:00; 2:00-4:00; Weds & Friday, 10:00 - 12:00 am.
   Osborne Undergraduate Learning Laboratory: Neuromechanical Laboratory.

Summary
This course will examine the neurophysiological processes and functional neuroanatomical components involved in the sensory and motor control of movement, posture and balance in the Human. Emphasis is placed on a critical analysis of the literature. Topics discussed will include how the muscle functions to generate movement (i.e. control of the “motor unit”), the neural processing and sensory “coding” demonstrated by peripheral receptors, the integration at the spinal cord via reflexes, up to sensorimotor functions at the level of the brainstem and brain. Wherever possible, clinical examples of neurological disorders, such as Post Polio Syndrome, Spinal Cord Injury, Stroke, Multiple Sclerosis, and other conditions that affect human movement control, will be discussed.

Global Learning Objectives
1. To explore the basic neurophysiological processes underlying the control of Human movement, kinaesthesia, posture and balance.
2. To explore the functional roles of the various peripheral and central nervous system (CNS) structures that are known to be involved in Human motor control.
3. To examine the impairment of motor control resulting from the various lesions and clinical pathologies of the CNS.

Course Learning Objectives:
By the end of this course, you will be expected to:
1) Think critically about the neurophysiological processes as they pertain to the control of human movement.
2) Be able to problem solve in the laboratory setting in the context of Human kinetics.
3) Be able to discuss critically the current scientific literature that uses neurophysiological techniques discussed within the lectures and demonstrated and worked on in the laboratories.
4) Demonstrate a professional behaviour within the laboratory and lecture setting, and toward class participation and involvement.

Prerequisites: 3rd year standing or permission of the instructor
I. Lecture Based Sessions – Lectures Tues/Thurs 12:30 – 2:00 pm. Biol Sciences, 2000

Outline of Lectured Topics
A. Muscles and Motor Units: The “Things” that do the moving.
   - Control of Muscle: Motor units, recruitment, fatigue, Gender?
   - Concepts of Motor task and set.
B. Somatosensory Receptors: The source of “the Code”.
   - The muscle spindle: I. Coding muscle length and velocity.
   - Gamma motorneurons and the muscle spindle.
   - Golgi tendon organs: coding muscle force
   - Joint receptors: joint position?
   - Cutaneous information - a changing role for skin?
   - Proprioception and kinaesthesia.
C. Spinal Cord Neurophysiology: The lower loops that bind us.
   - Spinal circuits and connections: The neural “freeway”?
   - The stretch reflex: reflexes and movement.
   - Long Latency Reflexes, supraspinal control of movement and locomotion.
   - Central Pattern Generators.
D. Posture and Balance: We’re so unstable!
   - The vestibular system.
   - The Motor and Sensory control of stance?
   - Vestibular, kinesthetic and visual roles in standing balance.
   - Clinical assessment of balance.

II. Laboratory sessions – There are 4 laboratory sections (L1A, L1B, L1C, L1D).
Students registered in the different laboratory sections are required to attend the labs ONLY at the times stipulated for that section. In each section, students will be assigned into 5 groups with 7-8 students per group. Attendance for the labs is NOT MANDITORY. There are no lab reports or assignments. Knowledge of lab-based material will be assessed in the in-class written Laboratory examination.

NOTE: There will be ONLY three laboratory weeks in KIN 389 in 2015.

Laboratory #1 – Week of Oct.6-Oct.9, 2015.
L1A, Oct. 6, 10:00 am - 12:00
L1B, Oct. 7, 10:00 am - 12:00
L1C, Oct. 9, 10:00 am - 12:00
L1D, Oct. 6, 2:00 – 4:00

L1A, Oct. 27, 10:00 am - 12:00
L1B, Oct. 28, 10:00 am - 12:00
L1C, Oct. 30, 10:00 am - 12:00
L1D, Oct. 27, 2:00 – 4:00

Laboratory #3 – Week of Nov. 17-Nov. 20, 2015.
L1A, Nov. 17, 10:00 am - 12:00
L1B, Nov. 18, 10:00 am - 12:00
L1C, Nov. 20, 10:00 am - 12:00
L1D, Nov. 17, 2:00 - 4:00
Course Evaluation

1. Midterm Lecture Examination (35%)
Date: Written in class on Oct. 15th, 2015

**NOTE:** If the student is unable to write (due to illness or absence, for any reason) or chooses not to write the midterm, then the final examination is worth 85% of the student’s final overall grade in the course. If the student elects to write the midterm examination, they will be given the option of dropping the midterm grade in favour of writing an 85% final. **This choice has to be made PRIOR to writing the final examination, by no later than Dec. 7th at 4:00 pm.**

2. Final Lecture Examination (50% or 85%)
Date: The date and time of the final exam will be set by the registrar during final exam period in December, Dec. 8th – 22nd, 2015.
**NOTE:** All students are required to write the final examination. The final examination is cumulative.

3. Laboratory Examination (15% of overall final grade)
Date: Written in class on Tues. Nov. 24th, 2015. All students will be required to answer questions directly relevant to the material covered in the laboratory sessions. This written examination will amount to 15% of the overall final grade.

**Refer to UBC calendar for policy and definitions of misconduct and plagiarism.**

Notes and Readings:

A. A package of readings will be made available for purchase through the UBC bookstore. Estimate - $20-30.
B. All lectures and MOST other literature (scientific article readings (PDF)) assigned during the term will be posted on UBC Connect page dedicated to KIN 389.

Suggested references are provided for each lecture from primarily two textbooks.
<table>
<thead>
<tr>
<th>Section</th>
<th>Date</th>
<th>Lecture</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Tues. Sept. 8&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Class cancelled - “IMAGINE”</td>
<td>E=Enoka, K= Kandel et al.</td>
</tr>
<tr>
<td></td>
<td>Thurs. Sept. 10&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Outline/Motor Units: Morphology</td>
<td>(p215-229); K-(p768-776).</td>
</tr>
<tr>
<td></td>
<td>Tues. Sept. 15&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Motor Units: Recruitment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thurs. Sept. 17&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Motor Units: Current research</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tues. Sept. 22&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Motor Units/Muscle: Summary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thurs. Sept. 24&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Graded potentials/synapse.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thurs. Oct 1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>The Muscle Spindle II: Efferent!</td>
<td>K- (p794-796, 802-804).</td>
</tr>
<tr>
<td></td>
<td>Tues. Oct. 6&lt;sup&gt;th&lt;/sup&gt;</td>
<td>The Muscle Spindle summary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thurs. Oct. 8&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Golgi Tendon Organs</td>
<td>E- (p254-255); K-(p800-801).</td>
</tr>
<tr>
<td></td>
<td>Tues. Oct. 13&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Joint Receptors</td>
<td>E- (p255-256).</td>
</tr>
<tr>
<td></td>
<td>Thurs. Oct. 15&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Midterm Examination</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tues. Oct. 20&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Cutaneous Receptors.</td>
<td>E- (p256-257); K- (p498-511).</td>
</tr>
<tr>
<td></td>
<td>Thurs. Oct. 22&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>kinesthesis &amp; Proprioception #1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tues. Oct. 27&lt;sup&gt;th&lt;/sup&gt;</td>
<td>kinesthesis &amp; Proprioception #2</td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Thurs. Oct. 29&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Reflexes I: Basic loops</td>
<td>E- (p257-268); K- (p790-809).</td>
</tr>
<tr>
<td></td>
<td>Tues. Nov. 3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Reflexes II: Intermediate loops</td>
<td>E- (p257-268); K- (p790-809).</td>
</tr>
<tr>
<td></td>
<td>Thurs. Nov. 5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Reflexes III: Complex loops</td>
<td>E- (p276-281); K- (p812-833).</td>
</tr>
<tr>
<td>D.</td>
<td>Tues. Nov. 10&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Balance and Postural Control</td>
<td>E- (p272-276); K- (p935-959).</td>
</tr>
<tr>
<td></td>
<td>Thurs Nov. 12&lt;sup&gt;th&lt;/sup&gt;</td>
<td>The Vestibular System I</td>
<td>K- (p917-925).</td>
</tr>
<tr>
<td></td>
<td>Tues Nov. 17&lt;sup&gt;th&lt;/sup&gt;</td>
<td>The Vestibular System II</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thurs Nov. 19&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Balance: Sensory Integration</td>
<td>K- (p935-959).</td>
</tr>
<tr>
<td></td>
<td>Tues Nov. 24&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Laboratory Written Exam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thurs Nov. 26&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Class Cancelled.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tues. Dec. 1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Balance: Current views and issues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thurs. Dec. 3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Catch-up &amp; Course summary.</td>
<td></td>
</tr>
</tbody>
</table>