The University of British Columbia  
School of Kinesiology  

Kinesiology 500D - 2020

The Neurophysiology of Human Movement Control

Instructor: Dr. J. Timothy Inglis
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Office: Room 212
Unit 1, Osborne.
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Location and Time:
1. Lectures: Tues/Thurs., 9:30-10:50 am. Online
2. Seminar/Tutorial: Friday 1:00 – 2:00 (Attendance required). Online
3. Office hours: TBD
4. Tutorial times: To be announced during class.

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 (ie. 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, kinaesthesis, 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 discuss critically the current scientific literature that uses neurophysiological techniques discussed within the lectures.
3) Demonstrate a professional behaviour within the tutorial and lecture setting, and toward class participation and involvement.
4) Practice and demonstrate a concise and clear writing style assigned term paper.
5) Create and deliver a clear 30-minute presentation of the term paper.
I. Lecture Based Sessions – Lectures For KIN 313 Tues/Thurs 9:30 – 10:50 pm.

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.
   II. The Hoffmann reflex and Tendon Reflex
   - Golgi tendon organs: coding muscle force
   - Joint receptors: joint position?
   - Cutaneous information - a changing role for skin?
   - Proprioception and kinesthesis.
C. Spinal Cord Neurophysiology: The lower loops that bind us.
   - Spinal circuits and connections: The neural “freeway”?
   - The stretch reflex: reflexes and movement.
   - The Hoffmann and Tendon Reflexes.
   - Altered reflexes and ‘Tone’. Spasticity and Rigidity.
   - Long Latency Reflexes.
   - Central Pattern Generators and locomotion.
   - Complex Reflexive control.
D. Inner ear and Balance.
   - Anatomy of The Vestibular system.
   - linear and Angular acceleration.

Course Evaluation
1. Midterm Lecture Examinations (50%) Written during class online
   Dates:

2. Term Paper, Presentation, Participation (50%)
   A. Term Paper:
      Each graduate student will be required to draft a 15-20-page (including references) term paper
      focused on one specific topical area appropriate for this course and it’s content, that includes an
      introduction to the literature in that area, a proposed research question, and a brief outline of the
      methodology that could be used to test the theory outlined in this paper.
      Value: - 20% of overall Mark in course (Due, Tues Nov. 24th, 4:00 pm, 2020.)

   B. Term Paper Presentation:
      Students will be required to do a 30-minute summary presentation of their grant (minus budget) or
      term paper.
      Value: - 20% of overall Mark in course – Friday Nov. 27/Dec. 4th, 1:00 pm, 2020.

      NOTE: If the number of presentations extends beyond the available time, then a third presentation
      date will be determined, and will likely occur during the normal final examination window for term
      1.

   C. Participation:
      Students will be evaluated on a 10-point scale for the extent of their attendance, and participation in
      discussions during the presentations of the term papers and weekly tutorials.
      Value: - 10%
### TIMETABLE/DATES – ONLINE LECTURES

<table>
<thead>
<tr>
<th>Section</th>
<th>Date</th>
<th>Lecture</th>
<th>Readings</th>
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<tbody>
<tr>
<td>A.</td>
<td>Tues. Sept. 8&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Class cancelled - “IMAGINE”</td>
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<td></td>
<td>Thurs. Sept. 10&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Outline/Motor Units: Morphology</td>
<td>E- (p215-229); K-(p768-776).</td>
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<tr>
<td></td>
<td>Tues. Sept. 15&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Motor Units: Recruitment.</td>
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<td>Thurs. Sept. 17&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Motor Units: Current research</td>
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<td>Tues. Sept. 22&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Motor Units: Current research</td>
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<td>Thurs. Sept. 24&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Motor Units/Muscle: Summary</td>
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<td>B.</td>
<td>Tues. Sept. 29&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Graded potentials/synapse.</td>
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<td>Tues. Oct. 6&lt;sup&gt;th&lt;/sup&gt;</td>
<td>The Muscle Spindle II: Efferent!</td>
<td>K- (p794-796, 802-804).</td>
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<td>Thurs. Oct. 8&lt;sup&gt;th&lt;/sup&gt;</td>
<td>The Muscle Spindle summary</td>
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<td>Tues. Oct. 13&lt;sup&gt;th&lt;/sup&gt;</td>
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<td><strong>Midterm Examination #1</strong></td>
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<td></td>
<td>Thurs. Oct. 15&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Golgi Tendon Organs</td>
<td>E- (p254-255); K-(p800-801).</td>
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<td>Tues. Oct. 20&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Joint Receptors</td>
<td>E- (p255-256).</td>
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<td>Thurs. Oct. 22&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Cutaneous Receptors.</td>
<td>E- (p256-257); K- (p498-511).</td>
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<td>Tues. Oct. 27&lt;sup&gt;th&lt;/sup&gt;</td>
<td>kinesthesis &amp; Proprioception #1</td>
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<td>Thurs. Oct. 29&lt;sup&gt;th&lt;/sup&gt;</td>
<td>kinesthesis &amp; Proprioception #2</td>
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<td>Tues. Nov. 3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>kinesthesis &amp; Proprioception #2</td>
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<td>C.</td>
<td>Thurs. Nov. 5&lt;sup&gt;th&lt;/sup&gt;</td>
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<td><strong>Midterm Examination #2</strong></td>
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<td>Tues. Nov. 10&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Reflexes I: Basic loops</td>
<td>E- (p257-268); K- (p790-809).</td>
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<td>Thurs. Nov. 12&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Reflexes II: H and T Reflexes</td>
<td>E- (p257-261); K- (p808).</td>
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<td>Tues. Nov. 17&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Reflexes III: Intermediate loops</td>
<td>E- (p257-268); K- (p790-809).</td>
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<td>Thurs. Nov. 19&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Reflexes IV: Complex loops</td>
<td>E- (p276-281); K- (p812-833).</td>
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<td>Tues. Nov. 24&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Reflexes V: Current research</td>
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<td>Thurs. Nov. 26&lt;sup&gt;th&lt;/sup&gt;</td>
<td>The Vestibular System I</td>
<td>K- (p917-925).</td>
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<td>Tues Dec. 1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>The Vestibular System II</td>
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<td>Thurs Dec. 3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Course summary.</td>
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### TIMETABLE/DATES – ONLINE TUTORIALS/PRESENTATIONS.

- **Week #1** (Sept. 11) – Introduction to course. Assignments. Introduction.
- **Week #2** (Sept. 18) – Tutorial discussion – motorneurons and motor units.
- **Week #3** (Sept. 25) – Tutorial discussion – Assigned reading #1 discussion
- **Week #4** (Oct. 2) – Tutorial discussion – Muscle Spindles.
- **Week #5** (Oct. 9) – Tutorial discussion – Midterm #1 review
- **Week #6** (Oct. 16) – Tutorial discussion – GTO.
- **Week #7** (Oct. 23) – Tutorial discussion – Assigned reading #2 discussion
- **Week #8** (Oct. 30) – Tutorial discussion – Midterm review #2/Term Paper discussions
- **Weeks #9** (Nov. 6) – Tutorial discussion – Term paper discussions
- **Weeks #10** (Nov. 13) – Term paper preparation – NO ONLINE CLASS.
- **Weeks #11** (Nov. 20) – Term paper preparation – NO ONLINE CLASS.
- **Week #12** (Nov. 27) – Term Paper presentations #1.
- **Week #13** (Dec. 4) – Term Paper presentations #2.