

The University of British Columbia  
School of Kinesiology

**Kinesiology 389 (value: 3 credits)**

## **Neuromuscular Integration of Human Movement**

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**Teaching Assistants:**

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Kyle Johnston: to be announced.

### **Location and Time:**

1. Lectures: Tues/Thurs., 9:30-11:00 am. IRC (Woodward) Lecture Hall 6.
2. Office hours: By appointment.
3. Tutorial times: To be announced in 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, 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 discuss critically the current scientific literature that uses neurophysiological techniques discussed within the lectures and demonstrated and worked on in the laboratories.**
- 3) **Demonstrate a professional behaviour within the tutorial and lecture setting, and toward class participation and involvement.**

**Prerequisites:** 3<sup>rd</sup> year standing or by permission of the instructor (***no corequisite courses***)

## Course Structure:

This is a lecture based course. Each lecture is 1 hour and 20 minutes long in duration.

Lectures– Lectures Tues/Thurs 9:30 – 11:00 pm. IRC 6

### 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.
    - II. Gamma motorneurons and the muscle spindle.
  - 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 kinaesthesia
- 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. **Sensorimotor integration. Bringing sensory and motor together.**
  - The Vestibular system. VOR, Vestibulocollic and Vestibulospinal reflexes.
  - Supraspinal control of balance and locomotion (time permitting).

## Course Evaluation

### 1. Midterm Lecture Examinations (50%) Written in class

Dates:

1. **Oct. 15<sup>th</sup>, 2019** (worth 25% of overall mark in course).
2. **Nov. 12<sup>th</sup>, 2019.** (worth 25% of overall mark in course).

*NOTE: If the student is unable to write (due to illness or absence, for any reason) or chooses not to write one of the midterms, then the **final examination** will become worth **75 %** of the student’s **final overall grade** in the course. If the student elects to write the midterm examinations, they will be given the option of dropping **ONE** midterm grade, such that the final exam is worth 75% of the students final overall grade.*

**This choice has to be made by sending the course instructor an email PRIOR to writing the final examination, by no later than Dec. 2<sup>nd</sup> at 4:00 pm.**

### 2. Final Examination (50% or 75%)

Date: The date and time of the final exam will be set by the registrar during the final exam period in December, Dec. 3<sup>rd</sup> – 18<sup>th</sup>, 2019.

*NOTE: All students are **required** to write the final examination. The final examination is cumulative.*

## Course Notes and Readings:

- A. A package of readings will be made available for purchase through the UBC bookstore. Estimate - \$20-25.
- B. All lectures other literature (scientific article readings (PDF)) assigned during the term will be posted on UBC Canvas page dedicated to KIN 389. Lectures will be posted as Powerpoint as well as in PDF format.

**Suggested readings are provided for each lecture from primarily two textbooks.**

- 1) Neuromechanics of Human Movement (4<sup>th</sup> edition), Roger M. Enoka (published by Human Kinetics, 2008).
- 2) Principles of Neural Science (5<sup>th</sup> edition), Kandel, Schwartz, Jessell, Siegelbaum and Hudspeth (published by McGraw Hill, 2013).

## University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available on [the UBC Senate website](#).

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

## Copyright

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Students are permitted to record the class lectures if they first make a request to the course instructor in writing.

### **TIMETABLE/DATES**

<b>Section</b>	<b>Date</b>	<b>Lecture</b>	<b>Readings</b>
<b>E=Enoka, K= Kandel et al.</b>			
<b>A.</b>	Tues. Sept. 3 <sup>rd</sup>	Class cancelled - "IMAGINE"	
	Thurs. Sept. 5 <sup>th</sup>	Outline/Motor Units: Morphology	E- (p215-229); K-(p768-776).
	Tues. Sept. 10 <sup>th</sup>	Motor Units: Recruitment.	
	Thurs. Sept. 12 <sup>th</sup>	Motor Units: Current research	
	Tues. Sept. 17 <sup>th</sup>	Motor Units: Current research	
<b>B.</b>	Thurs. Sept. 19 <sup>th</sup>	Motor Units/Muscle: Summary	
	Tues. Sept. 24 <sup>th</sup>	Graded potentials/synapse.	
	Thurs. Sept. 26 <sup>th</sup>	The Muscle Spindle I: Afferents	E- (p249-254).
	Tues. Oct 1 <sup>st</sup>	The Muscle Spindle II: Efferent!	K- (p794-796, 802-804).
	Thurs. Oct. 3 <sup>rd</sup>	The Muscle Spindle summary	
	Tues. Oct. 8 <sup>th</sup>	Golgi Tendon Organs	E- (p254-255); K-(p800-801).
	Thurs. Oct. 10 <sup>th</sup>	Joint Receptors	E- (p255-256).
	Tues. Oct. 15 <sup>th</sup>	<u>Midterm Examination #1</u>	
	Thurs. Oct. 17 <sup>th</sup>	Cutaneous Receptors.	E- (p256-257); K- (p498-511).
	Tues. Oct. 22 <sup>nd</sup>	kinesthesia & Proprioception #1	
	Thurs. Oct. 24 <sup>th</sup>	kinesthesia & Proprioception #2	
	Tues. Oct. 29 <sup>th</sup>	Reflexes I: Basic loops	E- (p257-268); K- (p790-809).
	Thurs. Oct. 31 <sup>st</sup>	Reflexes II: H and T Reflexes	E- (p257-261); K- (p808).
	Tues. Nov. 5 <sup>th</sup>	Reflexes III: Intermediate loops	E- (p257-268); K- (p790-809).
Thurs. Nov. 7 <sup>th</sup>	Reflexes IV: Complex loops	E- (p276-281); K- (p812-833).	
<b>D.</b>	Tues. Nov. 12 <sup>th</sup>	<u>Midterm Examination #2</u>	
	Thurs Nov. 14 <sup>th</sup>	Reflexes V: Current research	
	Tues Nov. 19 <sup>th</sup>	The Vestibular System I	K- (p917-925).
	Thurs Nov. 21 <sup>st</sup>	The Vestibular System II	
	Tues Nov. 26 <sup>th</sup>	Course summary.	
Thurs Nov. 28 <sup>th</sup>	<u>Catch up if necessary.</u>		