

The University of British Columbia  
School of Kinesiology

**Kinesiology 313-001  
2024 – Term 1**

## **Neuromuscular Integration of Human Movement**

**Instructor:** Dr. J. Timothy Inglis

**NOTE:** (DO NOT email or try to contact the instructor through Canvas - I never check that email. Always email me directly at the above address).

### **Summary**

This course will examine the neurophysiological processes and functional neuroanatomical components involved in the sensory and motor control of movement 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 peripheral neuropathy, 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 muscle activation, somatosensory receptors, spinal reflexes, Kinesthesia on Human movement.
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 office hour setting, and toward class participation and involvement.**

**Prerequisites:** 3rd year standing or permission of the instructor.

## **I. Lecture Based Sessions.**

***NOTE: All lectures are in person, and are not recorded for posting in Canvas.***

### **Outline of Lectured Topics**

- A. Muscles and Motor Units: The “Things” that do the moving.**
- Control of Muscle: Motor units, recruitment, fatigue, Gender?
  - how to record motor unit behaviour in human subjects.
  - Concepts of Motor task and set.
  - The “size” principle.
- B. Somatosensory Receptors: The source of “the Code”.**
- The muscle spindle: I. Coding muscle length and stretch velocity. II. Gamma motoneurons.
  - The stretch 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.
  - Long Latency Reflexes.
  - Central Pattern Generators and locomotion.
  - The role of afferent feedback in modulating complex Reflexive control.
- D. Sensorimotor integration. Bringing sensory and motor together.**
- The Vestibular system. Galvanic Vestibular stimulation (GVS).
  - Supraspinal control of balance and locomotion (time permitting).

## **II. Course Evaluation\***

**1. Midterm Lecture Examinations** (Value - 50%) Written in class, and are NOT cumulative.

Dates:

1. **Oct. 15<sup>th</sup>, 2024.** (value 25% of overall mark in course).
2. **Nov. 19<sup>th</sup>, 2024.** (value 25% of overall mark in course).

***NOTE: If the student is unable to write (due to illness or absence, for any reason) or elects not to write a midterm examination, then that missing percentage will be added to the final examination.***

***There will be NO makeup midterm examinations in KIN 313.***

**2. Final Examination** (50% or 75% or 100%)

Date: The date and time of the final exam will be set by the registrar during the final exam period in December, between Dec. 10<sup>th</sup> – 21<sup>st</sup>, 2024.

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

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

### Notes and Readings:

All notes will be posted on UBC Canvas page dedicated to KIN 313.

All lecture slides will be posted as PPT and PDF format. **Suggested Textbook readings** to support the student for the lecture content will also be posted in Canvas, as will the scientific article readings (PDF) assigned during the term.

**Suggested Textbook readings** are provided for most lectures from primarily two textbooks. There are also other added readings to help support the student in understanding the content. All of this material will be posted on Canvas in the KIN 313 webpage.

- 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, 2015).
- 3) *Control of Human Voluntary Movement* (2<sup>nd</sup>, edition), John Rothwell (published by Chapman & Hall, 1994).

### TIMETABLE/DATES

Section	Date	Lecture
A.	Tues. Sept. 3 <sup>rd</sup>	Class cancelled - "IMAGINE"
	Thurs. Sept. 5 <sup>th</sup>	Outline/Motor Units: Morphology
	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
	Thurs. Sept. 19 <sup>th</sup>	Motor Units/Muscle: Summary
B.	Tues. Sept. 24 <sup>th</sup>	Graded potentials/synapse.
	Thurs. Sept. 26 <sup>th</sup>	The Muscle Spindle I: Afferents
	Tues. Oct 1 <sup>st</sup>	The Muscle Spindle II: Efferent!
	Thurs. Oct. 3 <sup>rd</sup>	The Muscle Spindle summary
	Tues. Oct. 8 <sup>th</sup>	Golgi Tendon Organs
	Thurs. Oct. 10 <sup>th</sup>	Joint Receptors
	Tues. Oct. 15 <sup>th</sup>	<a href="#"><u>Midterm Examination #1</u></a>
	Thurs. Oct. 17 <sup>th</sup>	Cutaneous Receptors.
	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	
C.	Thurs. Oct. 31 <sup>st</sup>	Reflexes II: H and T Reflexes
	Tues. Nov. 5 <sup>th</sup>	Reflexes III: Intermediate loops
	Thurs. Nov. 7 <sup>th</sup>	Reflexes IV: Complex loops
	Thurs. Nov. 14 <sup>th</sup>	Reflexes V: Current research
	Tues. Nov. 19 <sup>th</sup>	<a href="#"><u>Midterm Examination #2</u></a>
	Thurs. Nov. 21 <sup>st</sup>	The Vestibular System I
	Tues. Nov. 26 <sup>th</sup>	The Vestibular System II
D.	Thurs. Nov. 28 <sup>th</sup>	Catch up if necessary...
	Tues. Dec. 3 <sup>rd</sup>	Course summary.
	Thurs. Dec. 5 <sup>th</sup>	REVIEW.