

**Motor Control – EPHE 380 (A01)**  
**Winter Session (2<sup>nd</sup> Term), January to April, 2019**  
**Course Outline**

Time: Monday & Thursday, 11:30am – 12:50pm

Room: MCK 150

Website: [www.tophat.com](http://www.tophat.com), CourseSpaces, <http://www.krigolsonteaching.com>

**Instructor: Dr. Francisco Colino**

Email: [colino.francisco@gmail.com](mailto:colino.francisco@gmail.com)

Office: McKinnon 186

Office Hours: By Appointment

**A little bit about your Instructor**

My name is Francisco Colino and my family emigrated from Spain and arrived in Toronto where I was born. I grew up in Toronto (lots of stuff happened) and then I attended the UofT and received my Bachelor's degree in Physical Education & Health. I decided to move out west to UBC Okanagan in Kelowna and started a Master's degree in September 2008. However, very quickly, I realized that I wanted to pursue more advanced studies so I transferred into a PhD program early in 2010 where I began studying changes to skin sensitivity of the hands and arms when we move. I graduated with my PhD and soon after moved here where I'm a Postdoctoral fellow in the Neuroeconomics Laboratory. I played Varsity football in my undergrad and coached it at the pee-wee level. I love to travel and traveled to quite a few places (mostly Europe) but I'd love to see more places (any suggestions?). On my spare time, I work out at the gym, I'm a racing sailboat crew member and I dabble in clay (skeet) shooting.

**Lab Coordinator: Holly Murray**

Email: [hmurray@uvic.ca](mailto:hmurray@uvic.ca)

Phone: 250 721 8388

Office: McKinnon 164

Office Hours: By Appointment

**Laboratory Sessions**

Lab Group 1 (B01): Tuesday 2:30 to 4:20 pm

Lab Group 2 (B02): Tuesday 4:30 to 6:20 pm

Lab Group 3 (B03): Thursday 2:30 to 4:20 pm

Lab Group 4 (B04): Thursday 4:30 to 6:20 pm

**Required Book and Materials**

Kandel, E., et al., Principles of Neural Science, 5<sup>th</sup> Edition

**You don't need to buy the book** as I provide you with pdf files of relevant chapters.

But, you're free to buy it, if you want, and retails for ~\$120 on Amazon.ca. All other

reading materials, videos, and webpages will be available as PDFs or links on

TopHat.com. You may join the course with the following code: 029395.

### Prerequisites and Registration

If you're registered in this class then you must have successfully completed EPHE 245 Motor Learning. Students also need to be accepted into a program in the School of Exercise Science, Physical, and Health Education.

If you want to pass this class **you need to be registered in a lecture section AND a lab section**. If you're only registered in one of these sections, then I will drop you from this class. The reason for this is that the lab component is a critical part of this class and, a really a great way to learn about motor control neuroscience is to actually do it yourselves.

### Course Description

An examination of the neural processes involved in the maintenance of posture, the control of movement, and issues related to understanding the cerebral organization of goal-directed movement. Includes discussion of certain movement disorders and the relationship of disturbances to stages in the sequence of information processing.

### Course Overview

<i>Theme</i>	<b>Introductory</b>	<b>Intermediate</b>	<b>Advanced</b>	<b>Expert</b>
<i>I. Neurons</i>	Sensory and Motor Neurons	Primary Motor Cortex and Primary Sensory Cortex  Corticospinal Tracts	Neuron Function and Communication	Sparse Neural Coding
<i>II. Postural Control and Gait</i>	Reflexes I	Reflexes II	Balance	Central Pattern Generators
<i>III. Movement Planning</i>	Movement Planning	Premotor Cortex	Basal Ganglia Cerebellum	Inverse Models
<i>IV. Movement Control</i>	Vision	Action – Perception  Posterior Parietal Cortex	Online Control	Forward Models

### **Course Goals**

My primary goal for this course is for you to learn about human neuromotor control. I will accomplish this by exposing you to traditional classroom lecture sessions, in class laboratories, and in-class discussion sessions.

Furthermore, the pursuit of scientific research, and largely your entire life, requires actively learning and performing practical skills. In keeping with that presupposition, to pass this course you need to pass the laboratory components of this course. I'm not actively trying to make your life more difficult out of malice – not at all! Rather, I, along with the lab team, am trying to prepare you for life after you leave EPHE at UVic. My ultimate goal is to train good, competent and critically thinking people. To make my point: think about an exemplar individual who you admire and ask yourself how that person achieved what he or she achieved. Conscientiousness (i.e., hard work), and intelligence to some extent, robustly predicts future achievement (see Jackson & Roberts, 2017. Conscientiousness in The Oxford Handbook of the Five Factor Model, (T.A. Widiger, ed., Oxford: London). I have provided a pdf copy of that chapter for you to read at your leisure.

### **Academic Concessions**

I am indeed happy to accommodate absences from lectures and labs. But, to keep everything fair and objective for everyone taking this course, and keeping with UVic policy, any late work or absences will be treated as unexcused unless you provide me (or lab TAs for lab work) one of the following in writing: personal illness or accident; family affliction; or absence due to official University activity (Varsity athletics). Those granted a concession be allowed to complete the work late at my discretion. Also, in the interest of fairness for everyone who diligently and conscientiously do their work and you haven't provided written reason for absence or lateness of work, I must assign a grade of zero (0) for the missed/late component. This is the part I really dislike about teaching and I really don't want to do it but I will if I have to.

### **Learning Styles, Learning Needs, and Disabilities**

I'm open and welcoming to students with diverse learning styles and needs. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the Centre for Accessible Learning (CAL) as soon as possible. The CAL staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations <https://uvic.ca/cal>, the sooner you let me know your needs the quicker I can assist you in achieving your learning goals in this course.

### **Academic Integrity**

Again, this really goes without saying but I'll state it anyway: please, for your grandma's sake don't cheat or copy anyone else's work! Honestly, it harms you and the community to be academically dishonest. Frankly, the TA's and I are very, very good at picking out plagiarized work. It makes sense given we read hundreds, if not thousands, of papers

and exams. Academic integrity is intellectual honesty and responsibility for academic work that you submit individual or group work. At the risk of sounding like an old, grouchy man (which I'm not by the way) responsibility is paramount to live a good life. It involves commitment to the values of honesty, trust, and responsibility. I want you to and demand that you respect these ethical values in all activities related to learning, teaching, research, and service. Therefore, plagiarism and other acts against academic integrity are serious academic offences.

#### My responsibility and promise to you

Me as an instructor, and EPHE, are tasked to ensure that standards of academic honesty are met. By doing so, the instructor and institution recognize students for their hard work and assures them that other students do not have an unfair advantage through cheating on essays, exams, and projects.

#### The responsibility of the student

Plagiarism sometimes occurs due to a misunderstanding regarding the rules of academic integrity, but you need to know these rules. If you are unsure about the standards for citations or for referencing your sources, ask me. In cases, where I suspect academic dishonesty, and depending on the severity, I will report the event to the department. In which case, penalties may be handed down to you.

It is your responsibility to understand the University's policy on academic integrity:

<https://web.uvic.ca/calendar2018-09/undergrad/info/regulations/academic-integrity.html>

#### **Other Information**

It's important that you familiarize yourself with all university policies and regulations related to other course issues.

#### **Changes to Course Outline**

Since this is my course and I'm the instructor, I reserve the right to change this course outline at my discretion as I feel fit to do. This course outline is not a binding contract.

#### **Assessment and Evaluation**

Exam One	15%
Exam Two	15%
Laboratory Research Paper	15%
Movement Disorder Poster Assignment	10%
Participation	15%
Final Exam	30%
<b>Total</b>	<b>100%</b>

NOTE: There are grade restrictions in place for this course - see below.

## Assessment Breakdown

### Exam One

15% of course grade  
Multiple Choice, 1 Short Essay Question  
Monday February 11<sup>th</sup>, 2019

On the day of the exam I will randomly select one of the four exam questions that have been covered (Section I: Questions 1 through 4) up to this time and you will answer it. Guidance on how to prepare for the essay exam will be provided in a subsequent lecture but the attached rubric will assist you in preparation as well. The rubric used for grading the essay question is provided at the end of this course outline. In line with the course policy on exam redos, you will have ONE opportunity to redo Exam One.

### Exam Two

15% of course grade  
Multiple Choice, 1 Short Essay Question  
Monday, March 18<sup>th</sup>, 2019

On the day of the exam I will randomly select one of the four exam questions that have been covered (Section II: Questions 5 through 8) since the last exam and you will answer it. Guidance on how to prepare for the essay exam will be provided in a subsequent lecture but the attached rubric will assist you in preparation as well. The rubric used for grading the essay question is provided at the end of this course outline. In line with the course policy on exam redos, you will have ONE opportunity to redo Exam Two.

### Laboratory Research Paper

15% of course grade  
1 research paper (see )  
See Laboratory Schedule below

As a part of the laboratory portion of the course you will conduct a research project and write a complete research paper in a small group. See the laboratory manual for more detail.

### Movement Disorder Poster

10% of course grade  
1 poster presentation (**see laboratory manual**)  
See Laboratory Schedule below

As a part of the laboratory portion of the course you will create and give a poster presentation in a small group about a specific assigned movement disorder. See the laboratory manual for more detail.

### Participation

15% of course grade  
Assessed at all time during lectures

As part of the course, I want to formalize and recognize your participation in class activities. For that I will keep track of attendance at lectures and whether you participate in class discussions.

## Final Exam

30 to 60% of course grade  
Multiple Choice, 2 to 4 Short Answer Essay  
Questions  
University Exam Period

On the final exam there will be six sections of questions (Sections I through VI). I will randomly select one question from each of the six sections rolling a die. You will answer all six questions. But, if you are happy with your Exam Score for the questions from Section I (i.e., Exam One) you do not need to answer the question from Section I. In a similar manner, if you are happy with your Exam Score for the questions from Section II (i.e., Exam Two) you do not need to answer the question from Section II. As such, the final will have a variable weighting dependent on your choices. The base weight of the final exam is worth more than the first two exams because there are two sections of material to prepare above and beyond Sections I & II (see Exam Questions below).

### **Grade Restrictions**

To pass the course:	Passing grade in the lab, all activities/assignments completed.
To potentially get an "A" grade:	Presentation of your poster on Thursday, February 7 <sup>th</sup> , 2019 at our mini-conference.
To potentially get an "A+" grade:	Preparation of your paper for submission to an undergraduate research journal.

### **Missing / Late Work**

Any late work (assignments, labs, etc), if not accommodated, will be assigned a grade of zero. No exceptions.

### **Missed Exams**

Due to the rewrite policy, any missed exams will not be re-done. The student will be assigned a grade of zero and will simply have opportunities to write an exam. If a student misses the final exam, for an unexcused reason, you will be given an opportunity to rewrite the exam in April of 2019. In fairness, I can't grant other exceptions to this policy.

## Laboratory

All laboratory session will take place in Room 070 in the McKinnon Building and will take place either Tuesday and Thursday afternoons, depending on your lab section. Lab Sections B01 and B02 meet Tuesdays at 2:30 to 4:20 pm and 4:30 to 6:20 pm, respectively. Sections B03 and B04 meet Thursdays at 2:30 to 4:20 pm and 4:30 to 6:20 pm, respectively. We will introduce the laboratory part of the course on Monday January 7, 2018 in regular lecture time.

## Laboratory Paper Re-dos

In the laboratory section, you have the opportunity to re-do and re-submit sections of your research paper, according to the following table:

Paper Section	Due Date	Marked and returned by:	Redo due date:	Marked and returned by:
Introduction	Feb 5, 7	Feb 12, 14	Feb 26, 28	Mar 5, 7
Methods	Feb 26, 28	Mar 5, 7	Mar 12, 14	Mar 19, 21
Results	Mar 12, 14	Mar 19, 21	Mar 26, 28	Apr 2, 4
Final paper	Mar 26, 28	Apr 2, 4		

\*\*The different dates reflect due dates for lab sections on Tuesdays and Thursdays, respectively.

## Exam Re-dos

In this course you will have the opportunity to redo your class exams at the final exam. In other words, if you're not happy with your grade in either/both Exam 1 and Exam 2, you will have the opportunity for another crack at the same questions on the Final Exam.

For the lab assignments, you may submit your assignment/paper early for feedback before the deadline. To keep things fair no grade will be assigned if you hand in your assignment early for feedback. Note, there will be no resubmission of the verbal poster presentation nor the final research paper submission. However, your lab TAs can review these with you the week before they are due.

## Grades

Your final letter grade in the course will be based on your total point score in relation to the standardized University of Victoria grading scale. Final grades that end with a decimal point of 0.5 or above will be rounded to the next higher whole number, and grades that end with a decimal point below 0.5 will be rounded to the next lower whole number. The minimum percentage necessary for each grade is as follows:

### Letter Grades

Letter Grade	A+	A	A-	B+	B	B-	C+	C	D
Minimum Points	90	85	80	77	73	70	65	60	50

## **EPHE 380 Lecture Schedule January to April, 2019**

Monday, January 7 <sup>th</sup>	Lecture 0: Introduction to Course & Laboratory
Thursday, January 10 <sup>th</sup>	Seminar: Why do we and other animals have nervous systems?
Monday, January 14 <sup>th</sup>	Lecture 1: Neurons
Thursday, January 17 <sup>th</sup>	Lecture 2: Reflexes Movement Disorders: ALS (if enough time)
Monday, January 21 <sup>st</sup>	Neuroanatomy Assignment (work in-class)
Thursday, January 24 <sup>th</sup>	Neuroanatomy Assignment due and evaluate answers
Monday, January 28 <sup>th</sup>	In Class Lab: Closed versus Open Loop Control (t-tests)
Thursday, January 31 <sup>st</sup>	Lecture 3: Movement Planning
Monday, February 4 <sup>th</sup>	Lecture 4: Vision
Thursday, February 7 <sup>th</sup>	Poster Mini Conference (no lecture)
Monday, February 11 <sup>th</sup>	Exam One
Thursday, February 14 <sup>th</sup>	Lecture 5: Sensory and Motor Neurons
Monday, February 18 <sup>th</sup>	READING BREAK (NO CLASSES)
Thursday, February 21 <sup>st</sup>	READING BREAK (NO CLASSES)
Monday, February 25 <sup>th</sup>	Sensory Neuropathy: Class seminar and discussion
Thursday, February 28 <sup>th</sup>	Lecture 6: Balance
Monday, March 4 <sup>th</sup>	In Class Lab: Grip Force (Correlation)
Thursday, March 7 <sup>th</sup>	Lecture 7: Neural Basis of Movement Planning
Monday, March 11 <sup>th</sup>	Lecture 8: Online Control
Thursday, March 14 <sup>th</sup>	Class Discussion & Review
Monday, March 18 <sup>th</sup>	Exam Two
Thursday, March 21 <sup>st</sup>	Lecture 9: Neural Coding
Monday, March 25 <sup>th</sup>	Lecture 10: Central Pattern Generators
Thursday, March 28 <sup>th</sup>	Lecture 11: Internal and Inverse Models



Monday, April 1 <sup>st</sup>	Lecture 12: Forward Models
Thursday, April 4 <sup>th</sup>	Final Exam Review and Questions
Thursday, April 5 <sup>th</sup>	LAST DAY OF CLASSES
Monday, April 8 <sup>th</sup>	EXAM PERIOD BEGINS
Saturday, April 27 <sup>th</sup>	LAST DAY OF EXAM PERIOD

**EPHE 380 LABORATORY SCHEDULE 2019**

<b>Week of</b>	<b>2019</b>	<b>POSTER</b>	<b>EXPERIMENT</b>	<b>DUE</b>
Jan 8, 10	<b>Lab 1</b>	Start Research	Introduction to Methodology	
Jan 15, 17	<b>Lab 2</b>	Poster Tutorial	Discuss Research Questions / Design Play with Equipment	
Jan 22, 24	<b>Lab 3</b>	Review with TA if needed	How to Write Introduction Play with Equipment	
Jan 29, 31	<b>Lab 4</b>			<b>Poster Presentations</b>
Feb 5, 7	<b>Lab 5</b>		Data Collection How to Write Methods	<b>Introduction Due Poster Conference</b>
Feb 12, 14	<b>Lab 6</b>		Data Collection	
Feb 19, 21	<b>READING BREAK – NO LABS SCHEDULED</b>			
Feb 26, 28	<b>Lab 7</b>		Data Collection/Analysis How to Write Results	<b>Methods Due</b>
March 5, 7	<b>Lab 8</b>		Data Collection/Analysis	
March 12, 14	<b>Lab 9</b>		Data Collection/Analysis How to Write Discussion	<b>Results Due</b>
March 19, 21	<b>Lab 10</b>		Data Analysis Extra Help (if needed)	
March 26, 28	<b>Lab 11</b>		Extra Help (if needed)	<b>Research Paper Due</b>
April 2, 4	No labs scheduled			

## EPHE 380 Topic Study Questions

*Disclaimer: Exam questions may not have the exact same wording as below and I may ask different questions entirely. Also, you may be asked to integrate different topics into a coherent answer. As such, these questions are here only to help you study.*

### *Section I: Introductory Material*

- Q1: Discuss the basic anatomy and function of neurons.
- Q2: Outline the pathway and mechanism of reciprocal inhibition. Why is it needed?
- Q3: Outline what is meant by motor programs, motor schema, and motor primitives.
- Q4: Discuss the two-stream theory of visual processing.

### *Section II: Intermediate Material*

- Q5: Discuss How motor neurons contract muscle and how sensory neurons detect a muscle being stretched.
- Q6: Discuss at least three tiers of defense against postural instability.
- Q7: Discuss the role of following brain regions in movement planning and control: Primary Motor Cortex.
- Q8: Why do we need online control of movement and what is the evidence for it?

### *Section III: Advanced Material*

- Q9: Discuss the role of following brain regions in movement planning and control: Supplementary Motor Area, Lateral Premotor Area.
- Q10: Discuss the mechanism and purpose of central pattern generators.
- Q11: What is an inverse model? How is it used in movement planning and control?
- Q12: What is a forward model? How is it used in movement planning and control?

### *Section IV: Advanced Material*

- Q13: Discuss the role of following brain regions in movement planning and control: Parietal Cortex, Cerebellum.
- Q14: What is the role of the Basal Ganglia in motor planning and control?
- Q15: What is meant by sparse coding and why is it important?
- Q16: Why can't we tickle ourselves?

### *Section V: Other Topics*

- Q17: What is ALS? Discuss the mechanism, symptoms, and treatment strategies.
- Q18: Discuss the mechanism of a movement disorder of your choice.
- Q19: Why do we trip?
- Q20: How do you pick up and eat an apple?

### *Section VI: Lab Methods*

- Q21: Explain in detail one of the following experimental methodologies: EMG, EEG.
- Q22: What is a t-test and why is it used in data analysis?
- Q23: What is correlation and why is it used in data analysis?
- Q24: Explain why it is important to test large numbers of people in research studies and why it is important to repeat the same studies a few times.

## EPHE 380 LONG ANSWER GRADING RUBRIC

Name:

Overall Grade:

The answer contains all of the required content:				
1	2	3	4	5
not at all	below average	average	good	exceptional

The quality / amount of research:				
1	2	3	4	5
poor	below average	average	good	exceptional

The quality / amount of diagrams:				
1	2	3	4	5
poor	below average	average	good	exceptional

The quality / amount of references to neural structures:				
1	2	3	4	5
poor	below average	average	good	exceptional

The quality of the writing (i.e., organization, subtitles, etc):				
1	2	3	4	5
poor	below average	average	good	exceptional

The quality of the examples:				
1	2	3	4	5
poor	same as mine	okay	original	great

Things to excel and things to avoid:			
The Good			The Bad
Originality			Not enough diagrams
Great references			Not enough research
Great diagrams			Unoriginal examples
Included new material			Too short
Well written			Not enough depth
Easy to follow			More detail required
Lots of research			Hard to follow
Exceeded expectations			Did not answer the question
Join my lab, please			Missing key material

INDICATE YOUR GRADE FOR EACH OF YOUR ANSWER FOR EACH CATEGOTRY.  
ALSO INDICATE/CHECK ANY "GOOD" OR "BAD" ITEMS THAT YOU THINK ARE APPROPRIATE.