



COURSE OUTLINE

COURSE NAME / NUMBER
<i>BMEN</i>

TITLE OF COURSE	HOURS	SESSION	YEAR
<i>Computational Models in Neuroimaging</i>	<i>GFC Hours 3-0</i>	<i>Winter</i>	<i>2025</i>

1.0 CALENDAR DESCRIPTION

A comprehensive study of the application of computational neuroscience methods and models in neuroimaging including biophysical models of EEG and BOLD-fMRI generation, EEG inverse problem, estimation of functional and effective connectivity, and cross-frequency coupling, in 1 session / week, 3 hours / session (September 13 to December 6, 2018).

2.0 COURSE OBJECTIVES

To provide a background of modeling and estimation techniques so that students can read and critically evaluate computational neuroscience papers, as well as apply these methods and models to the study of EEG/MEG and fMRI signals.

3.0 LECTURES

LECTURE	SESSION	DAYS OF THE WEEK	START TIME	DURATION (minutes)	LOCATION
01	<i>Winter</i>	Wednesday	9:00	180	HSC 2923

4.0 COURSE INSTRUCTORS

NAME	TELEPHONE	OFFICE	EMAIL
Dr. Roberto Sotero Diaz	587-500-2964	HSC2923	roberto.soterodiaz@ucalgary.ca

5.0 COURSE PROGRAM

DATE	TOPIC	INSTRUCTOR(S)
Jan 9, 2025	Course Introduction. The neurophysics of EEG/MEG. The EEG forward problem.	Roberto Sotero Diaz
Jan 16, 2025	Mean field modeling of EEG/MEG generation: neural mass models, neural field models	Roberto Sotero Diaz
Jan 23, 2025	The EEG/MEG inverse problem	Roberto Sotero Diaz
Jan 30, 2025	Written test #1. Synchronization phenomena in brain networks: Kuramoto model	Roberto Sotero Diaz
Feb 6, 2025	Time-frequency analysis: filtering, Hilbert transform, cross-frequency coupling of neurophysiological signals	Roberto Sotero Diaz
Feb 13, 2025	Complexity analysis of EEG and fMRI signals. Analysis of BOLD-fMRI signals: functional connectivity	Roberto Sotero Diaz
Feb 20 2025	Review paper	Roberto Sotero Diaz
Feb 27, 2025	Analysis of BOLD-fMRI signals: effective connectivity (Granger causality, transfer entropy)	Roberto Sotero Diaz
Mar 6, 2025	Biophysical models of BOLD-fMRI generation	Roberto Sotero Diaz
Mar 13, 2025	Written test # 2	Roberto Sotero Diaz
Mar 20, 2025	Data-driven and model-driven approaches to EEG/fMRI integration	Roberto Sotero Diaz
Mar 27, 2025	Predictive coding and Bayesian inference in the brain	Roberto Sotero Diaz
Apr 3, 2025	Presentation of the final project	Roberto Sotero Diaz

6.0 REQUIRED COURSE MATERIAL

Nunez, P. L., Srinivasan. Electric fields of the brain: the neurophysics of EEG. Oxford University press.

Wibral, Michael, Vicente, Raul, Lizier, Joseph T. (Eds.) Directed information measures in neuroscience. <http://www.springer.com/gp/book/9783642544736>

Buxton, R. B., K. Uludag, D. J. Dubowitz and T. T. Liu (2004). "Modeling the hemodynamic response to brain activation." Neuroimage 23 Suppl 1: S220-233.

Grech, R., T. Cassar, J. Muscat, K. P. Camilleri, S. G. Fabri, M. Zervakis, P. Xanthopoulos, V. Sakkalis and B. Vanrumste (2008). "Review on solving the inverse problem in EEG source analysis." J Neuroeng Rehabil 5: 25.

7.0 ASSIGNMENTS

1 Paper review (Feb 22, 2023)

8.0 QUIZZES AND EXAMINATIONS

Two written tests (October 4 and November 15, 2018) and one final project presentation (December 6, 2018)

9.0 CALCULATORS

10.0 FINAL GRADE DETERMINATION

The final grade in BMEM 600 will be determined based on the following components:

1 Review Paper	20
2 Written tests	40
1 Presentation	40
TOTAL	100%

11.0 ABSENCES

Absences are discouraged. If a student needs to miss a class, it cannot be on the day of a test without a doctor's note or a signed explanation from the student's supervisor. Should a student have a conflict on the scheduled test day, they must make arrangements with the course instructor as soon as possible.

12.0 PLAGIARISM / CHEATING / OTHER ACADEMIC MISCONDUCT

Plagiarism is academic misconduct. The University of Calgary Calendar defines plagiarism as:

“submitting or presenting work in a course as if it were the student's own work done expressly for that particular course when, in fact, it is not.”

Please read the section in the University Calendar on Plagiarism/Cheating/Other Academic Misconduct which is available at:

<http://grad.ucalgary.ca/calendar>