

# Mathematics for Biological Networks

## Introduction

This summer school consists of two parts:

- The first half is from May 10 to May 20, on [infectious disease networks](#).
- The second half is from May 23 to June 2, on [the dynamics of neuronal networks](#).

## Place

- All lectures take place in Social Science and Mathematics building (SSM), Room A104.
- All labs and tutorials take place in Human and Social Development building (HSD), Room A170.

## Marking Scheme for Students Taking the Course for Credit

First Half Exercises	25%
<a href="#">First Half Project</a> Presentation	5%
<a href="#">First Half Project</a> Paper	20%
Second Half Exercises	25%
<a href="#">Second Half Project</a> Presentation	5%
<a href="#">Second Half Project</a> Paper	20%

Only part of the exercises will be graded

## Sponsors

This event is sponsored by:



PIMS sponsorship is via IGTC.

## First Half: Infectious Disease Networks

### Date

May 10, 2010 – May 20, 2010

### Lecturers

Julien Arino (University of Manitoba)  
Shweta Bansal (Penn State University)  
Fred Brauer (University of British Columbia)  
Junling Ma (University of Victoria)  
Babak Pourbohloul (University of British Columbia, BCCDC)  
Pauline van den Driessche (University of Victoria)  
Jianhong Wu (York University)  
Bahman Davoudi (University of British Columbia, BCCDC)  
Rafael Meza (University of British Columbia, BCCDC)

## Programme for First Half

### Rooms

- Lectures in the mornings are in SSM A104, with refreshments served in the foyer
- Labs in the afternoons are in the HSD building, Room A170 (also open from 18:00-22:00)

### Monday May 10

Time	Topics	Lecturer
09:00-09:15	Summer School Introduction	
09:15-10:20	<a href="#">Introduction to deterministic epidemic models I</a>	Fred Brauer
10:20-10:40	Break + refreshments	
10:40-12:00	<a href="#">Disease data analysis</a>	Junling Ma
12:00-13:30	Lunch Break	
13:30-14:50	<a href="#">Introduction to computer labs and to available software</a> (e.g. Matlab )	Bahman Davoudi
14:50-15:10	Break	
15:10-16:30	<a href="#">Introduction to Python/NetworkX I</a>	Rafael Meza

### Tuesday May 11

- Hand in the list of 3 projects picked in the order of preference at 1:30PM

Time	Topics	Lecturer
09:00-10:20	<a href="#">Introduction to deterministic epidemic models II</a>	Fred Brauer
10:20-10:40	Break + refreshments	
10:40-12:00	<a href="#">The basic reproduction number</a>	Pauline van den Driessche
12:00-13:30	Lunch Break	
13:30-14:50	<a href="#">Introduction to Python/NetworkX II</a>	Rafael Meza
14:50-15:10	Break	
15:10-15:40	Assignment of group projects	Julien Arino
15:40-16:30	<a href="#">Matlab Tutorial II</a>	Bahman Davoudi

### Wednesday May 12

Time	Topics	Lecturer
09:00-10:20	<a href="#">Metapopulation models</a>	Julien Arino
10:20-10:40	Break + refreshments	
10:40-12:00	<a href="#">Introduction and background for disease network models</a>	Shweta Bansal
12:00-13:30	Lunch Break	
13:30-14:50	<a href="#">Matlab and Network Simulations</a>	Bahman Davoudi
14:50-15:10	Break	
15:10-16:30	Lab and exercises	

## Thursday May 13

Time	Topics	Lecturer
09:00-10:20	<a href="#">Introduction to probability and generating functions</a>	Rafael Meza
10:20-10:40	Break + refreshments	
10:40-12:00	<a href="#">Statistical mechanics of networks</a>	Babak Pourbohloul
12:00-13:30	Lunch Break	
13:30-15:10	Review schedule Exercises and working on group projects to decide model(s)	
15:10-15:30	Break	
15:30-16:30	<a href="#">Special Seminar</a>	Mark Lewis

## Friday May 14

Time	Topics	Lecturer
09:00-10:20	<a href="#">Final-size epidemic analysis on infinite-size networks</a>	Shweta Bansal
10:20-10:40	Break + refreshments	
10:50-12	<a href="#">Spatial epidemic models</a>	Jianhong Wu
12:00-13:30	Lunch Break	
13:30-14:50	Exercises and work on group projects	
14:50-15:10	Break	
15:10-16:30	Each group presents a max of 10 minutes on their project	

## Saturday May 15

- Work on your own

## Sunday May 16

- For students taking the course for credit: hand in Exercises I at 9:00am.

Time	Topics	Lecturer
09:00-10:20	Case study: <a href="#">West Nile virus</a>	Jianhong Wu
10:20-10:40	Break + refreshments	
10:40-12:00	<a href="#">Final-size epidemic analysis on directed and semi-directed networks</a>	Babak Pourbohloul
12:00-13:30	Lunch Break	
13:30-14:50	Exercises and work on group projects	
14:50-15:10	Break	
15:10-16:30	Exercises and work on group projects	

## Monday May 17

Time	Topics	Lecturer
09:00-10:20	<a href="#">Multi-type networks</a>	Rafael Meza
10:20-10:40	Break + refreshments	
10:40-12:00	<a href="#">Network structure dynamics</a>	Shweta Bansal
12:00-13:30	Lunch Break	
13:30-14:50	Exercises and work on group projects	
14:50-15:10	Break	
15:10-16:30	Exercises and work on group projects	

## Tuesday May 18

Time	Topics	Lecturer
09:00-10:20	<a href="#">Epidemic analysis on finite-size networks using the concept of generations</a>	Babak Pourbohloul
10:20-10:40	Break + refreshments	
10:40-12:00	<a href="#">Estimation of the basic reproduction number</a>	Bahman Davoudi
12:00-13:30	Lunch Break	
13:30-14:50	Prepare group presentations	
14:50-15:10	Break	
15:10-16:30	Prepare group presentations	

## Wednesday May 19

Time	Topics	Lecturer
09:00-10:20	<a href="#">Continuous-time epidemic analysis on finite-size networks</a>	Bahman Davoudi
10:20-10:40	Break + refreshments	
10:40-12:00	Case study: <a href="#">Influenza</a>	Fred Brauer
12:00-13:30	Lunch Break	
13:30-14:50	Finalize group presentations	
14:50-15:10	Break	
15:10-16:30	Finalize group presentations	

## Thursday May 20

- For students taking the course for credit: write up the group project and hand in by 9:00

Time	Topics
09:00-09:25	Group presentation
09:30-09:55	Group presentation
10:00-10:25	Group presentation
10:25-10:45	Break + refreshments
10:45-11:10	Group presentation
11:15-11:40	Group presentation
11:45-12:10	Group presentation
12:15-12:30	Concluding remarks

- For students taking the course for credit: hand in Exercises II at 9:00am on Sunday May 23.
- Conclusion of the first half of the summer school.

## Second Half: Neuronal Networks

### Date

May 23, 2010 – June 2, 2010

### Lecturers

Kerry Delaney (University of Victoria)  
Rod Edwards (University of Victoria)  
Bard Ermentrout (University of Pittsburgh)  
Jonathan Rubin (University of Pittsburgh)  
Stefanos Folias (University of Pittsburgh)  
Cheng Ly (University of Pittsburgh)

### Programme for Second Half

### Rooms

- Lectures in the mornings and afternoons are in SSM A104, with refreshments served in the foyer
- Labs in the afternoons are in the HSD building, Room A170 (also open from 18:00-22:00)

### Sunday May 23

- For students taking the course for credit: hand in Exercises II at 09:00am

Time	Topics	Lecturer
09:00-9:15	Summer school (2nd half) introductions	
9:15-10:20	<a href="#">Intro to the nervous systems/open questions in neuroscience</a>	Rubin
10:20-10:40	Break + refreshments	
10:40-12:00	Overview of experimental methods in neuroscience	Delaney
12:00-13:30	Lunch break	
13:30-14:50	Intro to membranes, equivalent circuits	Rubin
14:50-15:10	Break	
15:10-16:30	<a href="#">Phase-plane and bifurcation review</a>	Edwards

### Monday May 24

Time	Topics	Lecturer
09:00-10:20	<a href="#">Passive cables</a>	Rubin
10:20-10:40	Break + refreshments	
10:40-12:00	Hodgkin-Huxley model, and ion channels	Rubin
12:00-13:30	Lunch break	
13:30-14:50	<a href="#">Introduction to computer labs and to XPPAUT (I)</a>	Folias and Ly
14:50-15:10	Break	
15:10-16:30	<a href="#">Introduction to XPPAUT (II)</a>	Folias and Ly

## Tuesday May 25

Time	Topics	Lecturer
09:00-10:20	<a href="#">Reduced models I</a>	Rubin
10:20-10:40	Break + refreshments	
10:40-12:00	<a href="#">Reduced models II</a>	Rubin
12:00-13:30	Lunch break	
13:30-14:50	Bursting in single neuron models and mixed mode oscillations	Rubin
14:50-15:10	Break	
15:10-15:40	Assignment of group projects	Edwards
15:40-16:30	Computer lab/exercises	Folias and Ly

## Wednesday May 26

Time	Topics	Lecturer
09:00-10:20	Synapses	Rubin
10:20-10:40	Break + refreshments	
10:40-12:00	<a href="#">Central pattern generators (CPGs)</a>	Rubin
12:00-13:30	Lunch break	
13:30-14:50	<a href="#">Central pattern generators - a case study</a>	Edwards
14:50-15:10	Break	
15:10-16:30	Computer lab/exercises	Folias and Ly

## Thursday May 27

Time	Topics	Lecturer
09:00-10:20	Small networks	Rubin
10:20-10:50	Break + refreshments	
10:50-12:00	Synaptic plasticity	Rubin
12:00-13:30	Lunch break	
13:30-14:50	Parkinson's disease/Deep brain stimulation	Rubin
14:50-15:10	Break	
15:10-16:30	Computer lab/exercises	Folias and Ly

## Friday May 28

Time	Topics	Lecturer
09:00-10:20	Weak coupling and phase resetting curves (I)	Ermentrout
10:20-10:40	Break + refreshments	
10:40-12:00	Weak coupling and phase resetting curves (II)	Ermentrout
12:00-13:30	Lunch break	
13:30-14:50	Exercises and work on group projects	
14:50-15:10	Break	
15:10-16:30	Visit to Delaney lab	

## Saturday May 29

- Students work on their own

## Sunday May 30

Time	Topics	Lecturer
09:00-10:20	<a href="#">Firing rate models/pattern formation (I)</a>	Ermentrout
10:20-10:40	Break + refreshments	
10:40-12:00	Firing rate models/pattern formation (II)	Folias
12:00-13:30	Lunch break	
13:30-14:50	Exercises and work on group projects	
14:50-15:10	Break	
15:10-16:30	Exercises and work on group projects	

## Monday May 31

- For students taking the course for credit: hand in Exercises at 09:00am

Time	Topics	Lecturer
09:00-10:20	Basic stochastics	Ermentrout
10:20-10:40	Break + refreshments	
10:40-12:00	Stochastics and information theory	Ly
12:00-13:30	Lunch break	
13:30-14:50	Work on group projects	
14:50-15:10	Break	
15:10-16:30	Work on group projects	

## Tuesday June 1

Time	Topics	Lecturer
09:00-10:20	Propagation (I)	Ermentrout
10:20-10:40	Break + refreshments	
10:40-12:00	Propagation (II)	Ermentrout
12:00-13:30	Lunch break	
13:30-14:50	Work on group presentations	
14:50-15:10	Break	
15:10-16:30	Finalize group presentations	

## Wednesday June 2

- For students taking the course for credit: write up of group project and hand in by 9:00

Time	Topics
09:00-9:25	Group presentation
09:30-9:55	Group presentation
10:00-10:25	Group presentation
10:25-10:45	Break + refreshments
10:45-11:10	Group presentation
11:15-11:40	Group presentation
11:40-12:00	Concluding remarks

- Conclusion of the summer school.