MATH 475/575 [A01]
Dynamics of Regulatory Networks — course outline

Dept. of Mathematics and Statistics, University of Victoria
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Office hours:	Tue. 11:30–12:30; Wed. 2:30–3:30
Course web page:	CourseSpaces

Overview: I plan to cover material on dynamics of networks, mainly in the context of biochemical kinetics and gene regulation. Depending on time and student interest, we may be able to look a bit also at networks in other biological contexts, such as neuronal networks. Some emphasis will also be placed on general network principles applicable across applications, such as the role of negative feedback in producing oscillation.

Specific topics:

- Biochemical kinetic equations
- Models of gene expression - transcription, translation, post-translational modification
- Detailed and stochastic models of gene-regulatory networks (small-scale)
- Model reduction
- Simplified models of gene-regulatory networks (small or large scale)
- Boolean (discrete time) networks
- Dynamics of piecewise-linear networks
- Filippov method for differential inclusions
- Singular-perturbation method for "actively regulated" genes
- Network 'motifs'
- Negative feedback and oscillation
- Complex dynamics in networks and chaos
- Basics of mathematical neuroscience
- Small neuronal networks
- Neural connection architecture

Books and Articles: There will be no textbook for the course. Rather, we will use some material extracted from various textbooks as well as research papers. I will provide you with all of these.

Course structure: I propose to make the course a combination of lectures given by me, and presentations by students in the class on research papers they will read.

Mathematical background required:

- Linear Algebra, (e.g. MATH 110 or 211)
- Systems of Ordinary Differential Equations, (e.g. MATH 342)
- Qualitative Theory of Ordinary Differential Equations (e.g. MATH 342; 442 would be even better)
- Some Analysis and some Probability Theory may help, but the concepts we need can mostly be developed in the course
- Partial Differential Equations are not a main focus of the course, but may be useful for a few topics

Evaluation: Your understanding of the material will be evaluated by assignments, class presentations, and a major project. The weights of these components will be as follows:

Assignments:	60%
Class Presentations:	15%
Project:	25%

Assignments missed for a valid reason (illness, accident, family affliction) and supported by documentation will be waived. Your mark for assignments will then be calculated from a percentage of the total score of the remaining assignments. Class presentations will be scheduled towards the end of the term. If you cannot give a presentation for a documented valid reason (illness, accident, family affliction), your Project will count for 40% instead of 15%. Missing projects will simply be given a score of 0.

Departmental policies: can be found at

`https://www.uvic.ca/science/math-statistics/current-students/undergraduate/course-policies/index.php`.

We will operate according to these policies, so you should know what they say.