Systems and Synthetic Biology

(BIOL 4/6961 – BMED 4/6964 – CHEM 4/6963 – CHME 4/6961 – ECSE 4/6965)

Spring 2010

Instructors:	Cynthia Collins (ccolins@rpi.edu)
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Class Hours:	Tue 2-4pm (CII 3045) – Fri 2-5pm (CII 4040) – Lab (Walker 2214)
Office and Phone:	**CC -** CBIS 2125 (x4178); **AJ** - JEC 6044 (x6993)
Office Hours:	Mon 1-2pm + by appointment (**CC**); Mon & Wed 2-3pm (**AJ**)
Website:	http://www.ecse.rpi.edu/~agung/ecse6460/ecse6460.htm
	RPI LMS
Grading:	Homework sets (4 sets) + Lab reports (8 sets) = 40%
	Quizzes (3 sets) = 25%
	Class project (report + presentation) = 35%

Textbook: Uri Alon, *An Introduction to Systems Biology: Design Principles of Biological Circuits*, Chapman&Hall, 2007.

Additional reading materials will be made available during class.

Summary:

This course provides an overview of both natural and genetically engineered biological networks. Students will learn about several regulatory mechanisms in cellular biology, including genetic, proteomic, metabolic, and cross layer regulations. Both experimental and mathematical methods required to develop models of biological networks will be discussed. The course will involve both lecture and laboratory components.

In the Spring of 2010, this course will be supported by a small award from Rensselaer's Entrepreneurship Office. Entrepreneurial skills that benefit entrepreneurs and scientists, such as opportunity recognition, negotiation, and risk assessment will be presented. Real life examples of companies and products that have stemmed from the fields of systems and synthetic biology will also be discussed.

Learning Objectives:

The students are expected to understand the qualitative and quantitative aspects of the cellular biochemical processes related to the regulation mechanisms. The students are also expected to learn experimental techniques and mathematical tools that further enhance their understanding, especially on the application of the theory. Proficiency evaluation will be conducted through homework sets and quizzes. Laboratory work is evaluated through take home lab reports. Some computation tasks will be done with MATLAB. The course also includes a class project that requires teamwork and presentation skills.

Statement of academic integrity:

The Rensselaer Handbook of Student Rights and Responsibilities defines various forms of Academic Dishonesty and the students should make themselves familiar with these. All homework, lab reports and quizzes are expected to be individual work. You will work in groups for laboratory and MATLAB exercises and may discuss your results with your group or other classmates; however, the writing must be your own. Final written reports and oral reports will be done by groups. All reference materials (including web materials) used in preparation of reports must be cited appropriately using notes and/or a bibliography. One instance of unacceptable collaboration or plagiarism will result in a reduction of the final course grade by one letter grade (e.g. B to C). A second instance of academic dishonesty will result in failure of the course.

Tentative Course Outline:

Date	Day	Topic	Remark
26-Jan	Tue	Intro, course structure, course overview	
29-Jan	Fri	Central dogma of biology, mechanisms of gene expression, overview of multilayer network	HW 1
2-Feb	Tue	Metabolism and regulation	
5-Feb	Fri	**MATLAB + Lab I**	HW 1 due
9-Feb	Tue	Michaelis - Menten kinetics, models for feedforward and feedback regulation	
12-Feb	Fri	**MATLAB + Lab I**	Report due
19-Feb	Fri	**MATLAB + Lab II**	Report due
23-Feb	Tue	Network motifs, some literature review with examples of regulation	
26-Feb	Fri	**MATLAB + Lab II**	Report due
2-Mar	Tue	Review of random processes, stochastis simulation, consequences of noise in regulation	
5-Mar	Fri	Guest Lecture + entrepreneurship content + Test I	Report due + HW 2
16-Mar	Tue	Regulatory network identification, review of methods, and examples (I)	
19-Mar	Fri	**MATLAB + Lab III**	HW 2 due
23-Mar	Tue	Regulatory network identification, review of methods, and examples (II)	
26-Mar	Fri	**MATLAB + Lab III**	Report due
30-Mar	Tue	Review of computational and logical components, examples of synthetic parts	

2-Apr	Fri	Guest Lecture + entrepreneurship content + Test II	Report due
6-Apr	Tue	Cellular metabolism, review + examples of metabolic engineering	HW 3
9-Apr	Fri	**MATLAB + Lab IV**	
13-Apr	Tue	Models for metabolic network and analysis	HW 3 due
16-Apr	Fri	**MATLAB + Lab IV**	Report due
20-Apr	Tue	Synthetic Biology (Part 1)	HW 4
23-Apr	Fri	Synthetic Biology (Part 2)	Report due
27-Apr	Tue	Signaling networks, intercellular signaling and applications	HW 4 due
30-Apr	Fri	**Project Presentation**	
4-May	Tue	**Project Presentation**	
7-May	Fri	Modeling systems for synthetic networks	
11-May	Tue	Guest Lecture + entrepreneurship content + Test III	