**Department of Bioengineering - BIEN 580**
**Synthetic Biology**
**Syllabus**

**Course outline:**
Spanning the boundary of biology, engineering, and physical sciences, Synthetic Biology is broadly defined as the construction and reconstruction of biological systems for practical applications in research and industry. Emphasis is placed on fundamental knowledge and central technologies: engineering principles in biology, BioBricks and standardization of biological components, parts registries, advanced molecular biology tools for DNA assembly, genome editing, high-throughput genetic manipulation methods, construction of biological pathways, strategies for transcriptional control, examples of engineered systems.
The course will offer fundamental knowledge of central technologies in Synthetic Biology, advanced tools for integration of basic synthetic units into multi component devices, and modern analytical techniques for designing and testing new systems.

**Prerequisites:** Permission of instructor

**Audience:** This course is appropriate for upper-level undergraduate and graduate students, and also helpful for students interested in participating in the International Genetically Engineered Machine (iGEM) jamboree.

**Instructor:** Assist. Prof. Codruta Ignea (codruta.ignea@mcgill.ca)
Office Hours: By appointment.

**Course material:** There is no required textbook. Required reading materials (consisting of selected original research papers and review articles), lecture slides and assignments will be posted on the McGill myCourses site (accessible via www.mcgill.ca/lms).

**Course evaluation and grading:**

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| - Active participation during coursework. | 10% |
| - Assignments. | 30% |
| - Final exam | 60% |

**Final Exam:**

- Type of assessment**:**

Individual oral examination, 15-25 min (no preparation time) based on discussion/questions on the presentation of case study, written reports and on synthetic biology in general.

- Exam registration requirements:

The exam requires submission of one case study and one approved written experimental report. The case study will be developed during the course, handed in to the course instructor, and presented to the group before the examination.

- Re-exam

Re-exam as ordinary exam. If the requirements are not met, a report on a given topic must be handed in no later than 2 weeks before the re-exam.

**Learning Objectives:**

Participants enrolled in this course will:

- Obtain knowledge and understanding about synthetic biology and its importance in modern society.
- Learn basic concepts and advanced technologies that facilitate the building of biological parts and systems
- Understand current and future applications of synthetic biology
- Acquire practical skills to engage in interdisciplinary research.
- Consider ethical decisions and containment strategies in this field
- Become familiar with entrepreneurial aspects of using synthetic biology.

**Course Schedule:**

Week 1 - Introduction to Synthetic Biology. General concepts and enabling technologies.
Week 2 - Biological Parts. Modularity and Standardization. Part repositories
Week 3 - DNA synthesis and assembly. Genome Editing
Week 4 - Controlling Gene Expression and Protein Production. Optogenetics
Week 5 - Orthogonality, compartmentalization, synthetic biosystems
Week 6 - Case Studies - introduction
Week 7 - Construction of synthetic pathways, combinatorial biosynthesis.
Week 8 - Synthetic biology applications
Week 9 - Entrepreneurship, spin-offs and industrial enterprises. Biosafety
Week 10 - Case Studies - development
Week 11 - Case Studies - development
Week 12 -. Case Studies - development
Week 13 - Case Studies - presentation

**Teaching and learning methods:**

Delivery of material in lecture format (40%) Group work, active learning, case studies (30%) Demonstrations, experiments, simulations (30%)

**Language of Written Work:**
In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.

**Academic Integrity:**
McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information).

**Disabilities:**
If you have a disability, please contact the instructor to arrange a time to discuss your situation. It would be helpful if you contact the Office for Students with Disabilities at (514) 398-6009 before you do this.

**Case study:**
Structure:

1. Description of the problem (0.5 page)
2. Proposed solution (0.5 page)
3. Implementation (5 pages)
4. Feasibility of the project and alternative plan (what can go wrong/what will you do?) (1 page)
5. Biosafety - Biosecurity considerations (0.5 page)
6. Bioethics (0.5 pages)
7. Industrial application - product development - business model, if applicable (1 page)
8. Further expansions of the technology (1 page)
9. References

Must include the following:

- Considerations about abstraction/modularity
- Description of the chassis, parts and devices used
- Approaches towards standardization of the parts and (if possible/relevant) design of the biobricks used.

General guidelines:
Length: The size of each section shown above is the minimum and does not include figures. The total size of Sections 1-8 of the report should not exceed 30,000 characters or 15 pages when figures are added. Figure legends and Section 9 (References) is not considered in the page limit.
Format Letter, margins 2cm top, bottom, left, right; Font size 11, spacing 1.15.