Concordia Faculty of Arts and Science

SFYX Math 203/53 Fall 2021

Updated Course Outline

A Zoom-based Interactive Introduction to Differential Calculus

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The SFYX Interdisciplinary Computational Version of Math 203

The Faculty of Arts and Science of the university puts it this way*: First-year students pursuing a Bachelor of Science at Concordia will have the unique opportunity to engage in interdisciplinary, research-based approaches to the foundational sciences (chemistry, biology, physics) and mathematics. You'll gain a well-rounded understanding of a variety of science disciplines, see how they're connected, and explore how they impact society.*

The Concordia SFYX program of studies is described in the Academic Calendar of the university:

https://www.concordia.ca/artsci/academics/undergraduate/science-first-year-experience.html

The mathematical topics in this course follow the standard topics of an introductory course in **differential calculus**. However, the topics are motivated and illustrated with application from science (biology, chemistry), as well as other cognate fields.

The difference between a regular Math 203 course and its SFYX version lies in the balance between manual practice and the use of computer-based techniques used to solve real-world-type problems.

The academic goal of the course is to develop and use **computational thinking** as the operative principle of learning and using mathematics: **(D) define** the problem in natural language, **(A) abstract** its mathematical components in computational form, **(C) compute** the abstracted version of the given problem, **(I)** and **interpret** the obtained solution, in natural language. The **DACI** approach to computer-assisted problem-solving is known as **computational thinking**.

Students who are not in the SFYX program and who prefer pencil-and-paper learning should enrol in a regular section of Math 203.

Requirements

- SOFTWARE
  - **Mathematica,** a free download from your MyConcordia portal. Once installed on your computer (Mac or PC), you need to activate the software. Your *Concordia e-mail address* is your Activation Key.
- TEXTBOOK
  - Your textbook is the interactive electronic Mathematica version of **Calculus, Early Transcendentals, 3rd edition, by Briggs, Cochran, Gillett, and Schulz,** published by Pearson**.** You require a six-month subscription obtainable from the Pearson Learning website as described in detail on the course Moodle website.
- MYLAB/MATH
  - **All assignments and examinations** are randomized self-grading examinations posted in **MyLab/Math.**
  - **Practice examinations** are also posted in **MyLab/Math** and can be repeated as often as desired.
  - **Registration for MyLab/Math** is via the Pearson Learning link described in detail on the course Moodle website.
- MOODLE
  - Lecture notes, announcements, registration details, and other course-related material is shared via the course-related **Moodle website**.

Grading Scheme

1. Assignments (Weeks 1 to 10) - worth 10% of the final grade (Take-home)
2. Examination I (Week 4) - A Mathematica take-home examination worth 20% of the final grade
3. Examination II (Week 7) - A 2-hour MyLab/Math examination worth 20% of the final grade
4. Examination III (Week 10) A 2-hour MyLab/Math examination worth 20% of the final grade
5. Reflections (Weeks 1 to 10) - worth 10% of the final grade (Take-home)
6. Project (Weeks 11 to 13) A 20-page computational essay worth 20% of the final grade (Take-home)

Tutorials

- The tutorials for the SFYX version of Math 203 are different from those for the regular section. They introduce the technical aspects of the Tuesday lectures.
- Live tutorials are held online via Zoom on Mondays from 4:00 to 5:00. The tutorials are recorded and posted on the Moodle website for students who were unable to attend the live version. The URL for the tutorials is posted in the Announcement section of the Moodle course website.
- ***The lectures are based on the assumption that students have attended the tutorials and have used Mathematica to work through the material covered.***

Lectures

The lectures are interactive require Mathematica and Zoom. The URL for the Zoom-based lectures is posted in the Announcement section of the Moodle course website.

The lectures deal with calculus problems in science and related fields, solved with the Mathematica tools discussed in the tutorials of the associated lectures.

Participation at the lectures requires Mathematica and an Internet connection.

Assignments and Examinations

The assignments and examinations of the course are a combination of Mathematica and MyLab/-Math problem sets solved with Mathematica. Each assignment and examination is accompanied by a practice version to ensure that you have the opportunity to do well in the course.

- **Assignment 1 and Assignment 2 are based on Tutorials 1 and 2, and do not use MyLab/Math.**
- **Assignment 3 to 10 are randomized MyLab/Math quizzes whenever appropriate.**
- **Midterm 1 is a take-home examination based on Lectures 1, 2, and 3.**
  - **Students have one week to complete the examination from the date the examination template is released.**
  - **The specific deadline for the submission of completed examination is announced on Moodle.**
- **Midterm 2 are MyLab/Math examination held in Week 7.**
- **Midterm 3 are MyLab/Math examination held in Week 10.**

Reflections

All students are required to write *reflections* on ten lectures (Weeks 1 to 10) in class time and post their answers on the Moodle website of the course before the end of the lectures. Reflections should be answers to the following two questions, written by completing reflection templates. Students have fifteen minutes before the end of a lecture to write and post their answers.

- Question 1

Summarize in words what you have learned from today's lecture and from your participation in the class.

- *Question 2*

Summarize in words how, what you have learned today, fits into your previous knowledge or how you think you might be able to use it in the future.

Past students have found the writing of reflections an enjoyable and rewarding experience. Reflections also fit well into the goals and style of the SFYX approach to teaching and learning. The

students who wrote them in other courses found that the writing of reflections promotes understanding and retention of course material, encourages exploration, and fosters curiosity.

The posted reflections are **confidential to the students who wrote them.**

Week 1 - Mathematica and MyLab/Math

Tutorial 1

- A interactive Zoom introduction to computational learning with Mathematica, based on a lecture-specific problem from science, mathematics, or other cognate field of application

Lecture 1

This lecture is based on material in three places, found by clicking on the following hyperlinks:

- What is Mathematica?
- Fast Introduction to Mathematica for Math Students
- What is the MyLab/Math teaching and learning system?

Assignment 1

- Five examples of Mathematica numerically different from examples covered in Lecture 1.
- One example of a Mathematica natural-language query producing an answer to a calculus question.

Week 2 - A Library of Functions

Tutorial 2

- A interactive Zoom introduction to computational learning with Mathematica, based on a lecture-specific problem from science, mathematics, or other cognate field of application

Lecture 2

1. Review of functions (1.1)
2. Representing functions (1.2)
3. Inverse, exponential and logarithmic functions (1.3)
4. Trigonometric functions and their inverses (1.4)

- **Mathematica-based Assignment 2**
- **Reflections 2**

Week 3 - Limits of Functions

Tutorial 3

- A interactive Zoom introduction to computational learning with Mathematica, based on a lecture-specific problem from science, mathematics, or other cognate field of application

Lecture 3

1. The idea of limits (2.1)
2. Definition of limits (2.2)
3. Techniques of computing limits (2.3)
4. Infinite limits (2.4)
5. Limits at infinity (2.4)
6. Continuity (2.5)

- **MyLab/Math Assignment 3**
- **Reflections 3**

Week 4 - Midterm Examination I (Take-home)

Tutorial 4

- An interactive Zoom meeting to prepare for the Midterm Examination I

Midterm Examination (Covering Weeks 1, 2, 3)

- **MyLab/Math Assignment 4**
- **Reflections 4**

Week 5 - Derivatives of Functions (1)

Tutorial 5

- A interactive Zoom introduction to computational learning with Mathematica, based on a lecture-specific problem from science, mathematics, or other field cognate of application

Lecture 5

1. Introducing the derivatives (3.1)
2. The derivative as a function (3.2)
3. Rules of differentiation (3.3)
4. The product and quotient rules (3.4)
5. Derivatives of trigonometric functions (3.5)

- **MyLab/Math Assignment 5**
- **Reflections 5**

Week 6 - Derivatives of Functions (2)

Tutorial 6

- A interactive Zoom introduction to computational learning with Mathematica, based on a lecture-specific problem from science, mathematics, or other cognate field of application

Lecture 6

1. Derivatives as rates of change (3.6)
2. The chain rule (3.7)
3. Implicit differentiation (3.8)
4. Related rates (3.9)
5. Chapter 3 Review Exercises

- **MyLab/Math Assignment 6**
- **Reflections 6**

Week 7 - Midterm Examination II (Mathematica, Zoom and Internet Required)

Tutorial 7

- An interactive Zoom meeting to prepare for the Midterm Examination II
- **Randomized MyLab/Math Examination Covering Weeks 4, 5, 6**
- **MyLab/Math Assignment 7**
- **Reflections 7**

Week 8 - Applications of the Derivative (1)

Tutorial 8

- A interactive Zoom introduction to computational learning with Mathematica, based on a lecture-specific problem from science, mathematics, or other cognate field of application

Lecture 8

1. Maxima and minima (4.1)
2. What the derivative tells us (4.3)
3. Graphing functions (4.4)
4. Optimization problems (4.5)

- **MyLab/Math Assignment 8**
- **Reflections 8**

Week 9 - Applications of Derivatives (2)

Tutorial 9

- A interactive Zoom introduction to computational learning with Mathematica, based on a lecture-specific problem from science, mathematics, or other cognate field of application

Lecture 9

1. Linear approximations and differentials (4.6)
2. L'Hopitals's rule (4.7)
3. Newton's method (4.8)

4. Antiderivatives (4.9)

- **MyLab/Math Assignment 9**
- **Reflections 9**

Week 10 - Midterm Examination III (Mathematica, Zoom and Internet Required)

Tutorial 10

- An interactive Zoom meeting to prepare for the Midterm Examination III

Lecture 10

- **Randomized MyLab/Math Examination Covering Weeks 7, 8, 9**
- **MyLab/Math Assignment 10**
- **Reflections 10**

Week 11 - Project Step 1

1. Presentation and discussion of a past course project
2. Project purpose
3. Project format and project template
4. Three potential project topics
   4.1. Three Pros
   4.2. Three Cons
5. Three project bibliographies

- **A draft proposal, submitted as a Mathematica notebook, based on a reasoned discussion of (4), including a detailed bibliography for the chosen topic, must be uploaded to the Moodle website by midnight of Monday, Week 12. Step 1 counts for 5% of the final grade.**
- **All project-related material uses project-specific Mathematica templates.**

Week 12 - Project Step 2

1. Review and discussion of the submitted draft projects
2. Steps towards the project completion

- **A final project draft, submitted as a revised Mathematica notebook, must be uploaded to the Moodle website by midnight of Monday, Week 13. Step 2 counts for 5% of the final grade.**

Week 13 - Project Step 3

1. Comments on the submitted final draft projects
2. *Discussion and choice of the final submission deadline*
3. Discussion of Step 3, the completion of the course project, illustrated with past examples.
   - **The completion of Step 3 counts for 10% of the final grade.**