**Concordia University**

**Department of Electrical and Computer Engineering**

**COEN 231 - U – Introduction to Discrete Mathematics**

**Winter 2021 - Course Outline**

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**1. Course Description**

This course is an introduction to discrete mathematics. Students will comprehend various concepts and techniques (Foundations: logic and proofs; Basic Structures: sets, functions, sequences, sums; Induction and recursion; Solving Recurrences; Relations; Graphs; Trees, Finite State Machines, etc.) and learn to apply them through lectures, discussions, readings, individual assignments. Lectures: 3 hours per week. Tutorial: 1 hours per week.

**2. Course Objectives**

The objective of this course is to develop the students' knowledge of basic discrete mathematics concepts and develop reasoning skills. Students will learn how to reason using logic to solve problems, prepare proofs using a variety of techniques, learn how to work with discrete structures, and acquire the ability to count and enumerate objects using combinatorial analysis.

**3. Course Learning Outcomes (CLOs)**

Upon successful completion of the course, students will be able to

1. Use logical notation to model and reason about fundamental mathematical concepts such as sets, relations, functions, and integers.
2. Evaluate elementary mathematical arguments and identify fallacious reasoning.
3. Understand the notion of mathematical thinking, and mathematical proofs, and be able to apply them in problem solving.
4. Synthesize induction hypotheses and simple induction proofs.
5. Apply graph theory models to solve practical problems of engineering importance.
6. Understand and apply finite state machines in modeling computation.

**4. Graduate Attributes**

This course emphasizes and develops the CEAB (Canadian Engineering Accreditation Board) graduate attribute of “**A knowledge base for engineering”**. The attribute is defined by CEAB as follows: “Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.” This course contains some mathematical background required in many other engineering advanced courses and many real-world engineering applications. By the end of this course, students should learn a particular set of mathematical facts and how to apply them and more importantly should be able to think logically and mathematically. **Five important themes are interwoven in the textbook and lectures: mathematical reasoning, combinatorial analysis, discrete structures, algorithmic thinking, and application and modeling.**

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| --- | --- | --- | --- | --- |
| **Graduate Attribute** | **Indicator** | **Level of knowledge** | **CLO** | **Evaluation Method** |
| KB‐A knowledge base for engineering | ECE-KB-1. Knowledge base of mathematics  ECE-KB-3. Knowledge base in a specific domain (ELEC and COEN) | Intermediate  Intermediate | 1, 2, 3, 4  5, 6,7 | Assignments and exams |

**5. Course Evaluation**

There will be five (5) assignments, a midterm exam, and a final exam.

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| --- | --- | --- |
| **Evaluation Methods** | **Weights** | **Indicator** |
| Assignment 1 | 6 % | ECE-KB-1, ECE-KB-3 |
| Assignment 2 | 6 % | ECE-KB-1, ECE-KB-3 |
| Assignment 3 | 6 % | ECE-KB-1, ECE-KB-3 |
| Assignment 4 | 6 % | ECE-KB-1, ECE-KB-3 |
| Assignment 5 | 6 % | ECE-KB-1, ECE-KB-3 |
| Midterm (during May 28-June 2) | 30 % | ECE-KB-1, ECE-KB-3 |
| Final Exam (during June 18-23) | 40 % | ECE-KB-1, ECE-KB-3 |
| **TOTAL** | **100 %** |  |

**Notes:**

* All assignments and exams will be distributed and collected online in Summer 2020. The instructor reserves the right to conduct an individual oral examination after each exam to verify the student's response to specific questions.
* All students are expected to ensure access to internet and hardware equipment (computer, webcam, microphone) and to do online timed exams (if required).

**5.1 Assignments**

There will be **five assignments** that are worth 30% of the total grade. Instructions on will be posted on the Moodle course website. The tentative assignment schedule is as follows:

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| --- | --- | --- | --- |
| **Assignments** | **Posted on** | **Due on** | **Type** |
| Assignment 1 | Jan 22 | Feb 03 | Individual |
| Assignment 2 | Feb 10 | Feb 19 | Individual |
| Assignment 3 | Feb 23 | Mar 12 | Individual |
| Assignment 4 | Mar 17 | Mar 26 | Individual |
| Assignment 5 | April 2 | April 14 | Individual |

**Notes:**

* Assignments must be submitted via Moodle. Assignments sent by email may not be graded.
* Submit the signed [Expectations of Originality form](https://www.concordia.ca/content/dam/ginacody/docs/Expectations-of-Originality-Feb14-2012.pdf) with your name and student ID in print for each assignment.
* Late submissions BEFORE the solution is posted may subject to 50% late penalty. Late submissions AFTER the solution is posted will not receive any points.

**5.2 Midterm Exam**

There will be one midterm exam that is worth 30% of your total grade. The details and Instructions on the exam will be posted on the Moodle course website.

**5.3 Final Exam**

There will be one final exam that is worth 40% of your total grade. The details and Instructions on the exam will be posted on the Moodle course website. The exam date will be scheduled by the university.

**6. Course Organization**

**Moodle course website: (need registration)**

**6.1 Lectures and Tutorials**

All lectures and tutorials are scheduled online (accessible via Moodle) as follows.

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| --- | --- | --- | --- | --- |
| **Class** | **Class Title** | **Days & Time** | **Room** | **Class Dates** |
| **COEN 231-U (2204)** | **INTRO - DISCRETE MATHEMATICS (Lecture)** | **Wed-Fri 8:45AM - 10:00AM** | **Moodle - Online** | **Jan 13, 2021- April 15. 2021** |
| **COEN 231-UW UA (2204)** | INTRO - DISCRETE MATHEMATICS (Tutorial) | Friday 10:15AM-11:05AM | Moodle - Online | **Jan 13, 2021- April 15. 2021** |
| **COEN 231-W UB (2204)** | INTRO - DISCRETE MATHEMATICS (Tutorial) | Friday 11:45AM-12:35PM | Moodle - Online | **Jan 13, 2021- April 15. 2021** |
| **COEN 23-U UC (2204)** | INTRO - DISCRETE MATHEMATICS (Tutorial) | Friday 11:45AM-12:35PM | Moodle - Online | **Jan 13, 2021- April 15. 2021** |

**6.2 Textbook (Required)**

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| --- | --- |
| https://images-na.ssl-images-amazon.com/images/I/41z7wxgpJrL._SX385_BO1,204,203,200_.jpg | **Discrete Mathematics and Its Applications (8th Edition)**  Author: K Rosen  Publisher: McGraw-Hill Education  ISBN-10: 125967651X  ISBN-13: 978-1259676512  Publisher website for the textbook:  <https://www.mheducation.com/highered/product/discrete-mathematics-applications-rosen/M9781259676512.html> |

**Other Open Textbook Resources:**

* **Discrete Mathematics: An Open Introduction**

<https://aimath.org/textbooks/approved-textbooks/levin/>

* **Discrete Mathematics (Levin)**

<https://math.libretexts.org/Bookshelves/Combinatorics_and_Discrete_Mathematics/Book%3A_Discrete_Mathematics_(Levin)>

* Additional resources will be posted on the course website as the course progresses.

**7. Tentative Course Plan**

1. Binary Arithmetic: Base Conversion, Floating Point Notation: **Handout Material (Chapter 1 In Discrete Mathematics, By Giguere And Landsberger)**
2. Logic: Propositional Logic, Propositional Equivalence. **Chapter 1: 1.1, 1.2, 1.3**
3. Logic: Predicates & Quantifiers, Rules of Inference, Introduction to Proofs. **Chapter 1: 1.4, 1.5, 1.6, 1.7**
4. Set Theory: Sets, Set Operations. **Chapter 2: 2.1, 2.2**
5. Set Theory: Functions, Sequences and Summations. **Chapter 2: 2.3, 2.4**
6. Set Theory: Cardinality of Sets, Matrices. **Chapter 2: 2.5, 2.6**
7. Algorithms: **Chapter 3: 3.1**
8. Induction: Mathematical Induction. **Chapter 5: 5.1, 5.2, 5.3**
9. Relations Theory: Relations & Their Properties, Representing Relations, Equivalence, Partial Ordering. **Chapter 9: 9.1, 9.3, 9.4, 9.5, 9.6**
10. Solving Recurrence relations (**chapter 8**)
11. Graph Theory: Graphs & Graph Models, Graph Isomorphism, Connectivity, Euler & Hamilton Path. **Chapter 10: 10.1, 10.2, 10.3, 10.4, 10.5**
12. Trees. **Chapter 11: 11.1, 11.4, 11.5**
13. Finite State Machines. **Chapter 13: 13.1, 13.2, 13.3**

**8. Academic Honesty**

Violation of the Academic Code of Conduct in any form will be severely dealt with. This includes copying (even with modifications) of program segments. You must demonstrate independent thought through your submitted work. Click on the following link for more information:

<http://www.concordia.ca/students/academic-integrity.html>

**9. Course Expectation**

* Allcourse materials will be posted on Moodle: <https://moodle.concordia.ca/>. Please ensure your access to Moodle and contact [help@concordia.ca](mailto:help@concordia.ca) for any technical problems.
* Students are expected to attend every class. Some material may only be covered in class and not made available on the course website. Students are expected to read the assigned material and to actively participate in class discussions.
* Students are expected to be respectful of other people’s opinions and to express their own views in a calm and reasonable way. Disruptive behaviour will not be tolerated.
* Students shall be familiar with the Code of Rights & Responsibilities: <http://rights.concordia.ca>
* If you cannot attend class for any reason, unforeseen or not, you are to come and talk or write to me as soon as possible.
* Please note that you are responsible for ensuring appropriate, properly functioning technologies (webcam, microphone, Chrome browser, ability to download the required software, as well as a reliable internet connection with a minimum of a 3G connection).
* Please note that all live sessions (such as live lectures, live tutorials, etc.) will be **recorded**, including any questions that you asked during the sessions. You may use the Chat function or email offline to ask questions privately, if you do not wish to be recorded.
* Content belonging to instructors shared in online courses, including, but not limited to, online lectures, course notes, and video recordings of classes remain the intellectual property of the faculty member. It may not be distributed, published or broadcast, in whole or in part, without the express permission of the faculty member. Students are also forbidden to use their own means of recording any elements of an online class or lecture without express permission of the instructor. Any unauthorized sharing of course content may constitute a breach of the Academic Code of Conduct and/or the Code of Rights and Responsibilities.