

# Course Syllabus

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## MATH 260 | Sets and Logic

Winter 2020

### General Information

**Class Time:** M – F, 11:00am – 11:50am

**Location:** Samuelson 103

**Instructor:** Dr. Emilie Hancock

**Office:** Samuelson 218C

**Phone:** 509.963.2402

**Office Hours:** Tu, Th 12-2pm and by appointment (F2F or virtual) **Email:** emilie.hancock@cwu.edu

**Testing Hours:** M, Tu, W\*, Th, F 12-2pm (\*W until 1:45)

### Course Description and Learning Objectives<sup>1</sup>

The primary purpose of this course is to ramp up your ability to think and approach problems like mathematicians, providing a cognitive bridge between more procedural lower-level courses such as Calculus and upper-level abstract courses such as Real Analysis, Probability Theory, or Abstract Algebra. In transition courses such as this one, content goals take more of a back seat. The primary goals of the course are cognitive, helping you develop the habits of mind of mathematical thinkers and problem solvers such as thinking analytically, engaging in logical reasoning, communicating effectively and with precise language, and using mathematics to advance arguments and increase understanding. Emphasis is on process rather than content, and work with written and oral communication is an essential part of the course.

This course concentrates on training you in clear thinking and creative experimentation in the exploration of mathematical ideas. Because proof solidifies intuition into certainty, this course also focuses on the careful use of mathematical language, logical reasoning, and proof. Upon successful completion of this course, you should be able to:

- read, understand, and construct proofs
- write and speak about mathematics using precise mathematical language
- understand the role of definitions in mathematics and use (and possibly construct) them effectively
- understand elementary logical principles and proof techniques
- understand generalization and abstraction and their roles in mathematics
- know how to capture the essential elements of intuitive mathematical objects in precise language that can make them subject to rigorous mathematical analysis (e.g., definitions and axiom systems), and understand the importance of this process in mathematical discourse

Major content topics of the course include proper use of logical connectives and quantifiers, negation of mathematical statements, the equivalence of a statement and its contrapositive, direct proof, proof by contradiction, proof by induction, and basic set theory. Exploration of these topics will follow the outline:

**Unit 1:** Introduction to Proofs and Logical Reasoning (CH 1 and 2)

**Unit 2:** Constructing and Writing Mathematical Proofs (CH 3 and 4)

**Unit 3:** Proof in Context (CH 5 and 6)

## Required Materials

**Textbook:** *Mathematical Reasoning: Writing and Proof* (<https://scholarworks.gvsu.edu/books/9/>) by Ted Sundstrom. You can download the book online for free, or purchase a paper copy [online](https://www.amazon.com/Mathematical-Reasoning-Writing-Proof-Version/dp/1500143413/ref=sr_1_1?s=books&ie=UTF8&qid=1520897349&sr=1-1&keywords=t+sundstrom). ([https://www.amazon.com/Mathematical-Reasoning-Writing-Proof-Version/dp/1500143413/ref=sr\\_1\\_1?s=books&ie=UTF8&qid=1520897349&sr=1-1&keywords=t+sundstrom](https://www.amazon.com/Mathematical-Reasoning-Writing-Proof-Version/dp/1500143413/ref=sr_1_1?s=books&ie=UTF8&qid=1520897349&sr=1-1&keywords=t+sundstrom))

**Canvas Access:** I will update the course site on Canvas frequently with announcements, assignments, handouts, and due dates. Check Canvas daily.

## Grading Scale and Method of Evaluation

Final letter grades will be determined based on your weighted percent grade, rounded to the nearest whole percent.

| Letter Grade | F    | D     | D+    | C-    | C     | C+    | B-    | B     | B+    | A-    | A      |
|--------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Percent      | 0-59 | 60-66 | 67-69 | 70-72 | 73-76 | 77-79 | 80-82 | 83-86 | 87-89 | 90-92 | 93-100 |

Overall grades will be determined as a weighted average:

- 15% Pre-Class Assignments
- 7% Attendance and Professional Participation
- 63% 9 Mastery Exams (7% each)
- 15% Proof Portfolio

## Descriptions of Evaluation Components

### Pre-Class Assignments (15%)

Preview activities are designed for you to complete and submit *before* class. This work serves to motivate the upcoming topic and prepare you with necessary background information for in-class activities and discussions. Typically, you will need to read some sections of the textbook, watch some related videos for extra practice, and answer some questions to check for your current understanding of the material.

Don't worry if you don't understand all of the material the first time you see it - that's to be expected! These assignments are designed to introduce you to new ideas and terminology at a basic level so that, together, we can extend and practice these ideas in class in an active and engaged way.

### Attendance and Professional Participation (7%)

Your grade in this category is the percentage of class sessions you attend and participate professionally while present, recorded using Canvas [Roll Call Attendance](#). Regular attendance is essential for successful completion of this course.

You are allowed a **maximum of two unexcused absences** this quarter. Your third unexcused absence will result in an automatic grade of 0 in this evaluation category. Each unexcused absence after the second will result in an additional 10% off your overall course grade until your final course grade is 0.

As a member of a peer learning community, a high degree of professionalism is necessary. CWU expects every member of the university community to contribute to an inclusive and respectful classroom culture. I measure professional participation based on the following criteria:

- Arrive to class on time and stay for the entire class.
- Be present. Focus on learning by being an active participant. Limit side activities and put away cell phones. (If you are anticipating an emergency phone call, just let me know in advance.)
- Come to class prepared. You may need to finish up short activities between classes.
- Bring a positive and energetic attitude every day.
- Respect everyone, treat each other with dignity, and encourage all to participate.
- Participate in group work by asking questions, communicating your understanding to your groupmates, and completing the handouts.
- Present your ideas to the class and ask questions when other students present.
- Use a 3-ring binder to organize and promptly access class handouts, assignments, and notes.

A lack of professional participation will result in a loss of attendance/participation credit for the day. Severe or repeated lapses in professional judgment may result in disciplinary action up to and including failing the course.

### *Is my absence excused?*

Excused absences will not lower your overall grade in this class and are determined on a case-by-case basis. Excused absences are those that are both valid and verifiable, e.g. illness, bereavement, and school-related activities. Documentation is required. Excused absences do not include travel for holiday breaks, work, or non-emergency travel delays as determined by Central Washington University.

In compliance with [RCW 28B.137.010](https://apps.leg.wa.gov/rcw/default.aspx?cite=28B.137.010) (<https://apps.leg.wa.gov/rcw/default.aspx?cite=28B.137.010>), Central Washington University makes every effort to deal reasonably and fairly with students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Students must present written notice to their instructor within the first two weeks of class listing the specific dates on which accommodations are required. Contact the Dean of Student Success at (509) 963-1515 for further information or questions.

### *What if I miss class?*

- Communicate with me as soon as possible
- Get information about what will happen/happened in class
- If appropriate, send me supporting documentation for an excused absence
- For excused absences, make arrangements with me in advance for any adjustments to assignment deadlines

### **Standards-Based Content Mastery Exams (63%, 7% each)**

The purpose of this evaluation component is for you to demonstrate mastery of course content standards. Each mastery exam will assess a set of standards. Your final mastery exam grade is based on the total number of standards for which you have demonstrated mastery. This means you will not receive a numerical score for each question, but a percentage of standards mastered and standards to-be mastered.

|          |                              |  |
|----------|------------------------------|--|
| <b>E</b> | <b>Exceeds Expectations!</b> | Correct, complete, convincing, and clear.  |
| <b>M</b> | <b>Mastered</b>              | Demonstrates understanding of the relevant target. May include some errors, but no additional study or review is needed.         |
| <b>P</b> | <b>Progressing</b>           | Demonstrates partial understanding, but with a fundamental error, misunderstanding, or is incomplete. Needs review and revision. |

|          |                       |  |
|----------|-----------------------|--|
|          |                       |  |
| <b>X</b> | <b>Not Assessable</b> | Not enough work to determine mastery: An insubstantial attempt, too many errors to correct each individually, or uses an inappropriate method or tool. |

### Exam Attempts

Learning happens over time, as we revisit ideas and reflect on them. Your final grade in this evaluation component will reflect how well you *eventually understand* each topic. This grading system rewards **growth**; you can make mistakes without penalty, as long as you eventually demonstrate mastery of the topic.

Your first attempt for each exam will take place in class. See Canvas for this quarter's exam schedule and the standards assessed on each exam. No make-up of this first exam is allowed for an unexcused absence.

You will be given additional opportunities to demonstrate your mastery of any standards not yet mastered after the first attempt. You may only retest if you took the first in-class attempt, once each day until the exam retake deadline (see Canvas). Retakes during testing hours do not need to be scheduled in advance.

Testing hours this quarter: M, Tu, W\*, Th, F 12-2pm (\*W until 1:45)

### Proof Portfolio (15%)

While your written work on mastery exams provides a brief snapshot of your thinking (the end product), this evaluation component focuses on the reflective *process* crucial to developing the habits of mind of mathematical thinkers and problem solvers. Expert mathematicians have a high level of self-awareness, regularly engaging in metacognition (monitoring, regulating, and reflecting) while working on a mathematical proof or problem solving.<sup>2</sup> They reflect on their current strengths and weaknesses as they focus on developing aspects of mathematical creativity such as making connections and taking risks.<sup>3</sup> The goal of the proof portfolio is to build metacognitive skills by making your proof process explicit. Your portfolio includes seven submissions, one for each major proof method and a final reflection. Refer to Canvas Assignments for submission details.

## Academic Honesty<sup>4</sup>

In this class, we will use the following definition of plagiarism:

**Plagiarism** is the act of submitting the work of someone else as if it were your own. Specifically, this action intends to mislead the instructor to think that the work is the result of learning and understanding by the student named on the paper, when in fact the understanding truly belongs to someone else. This may apply to an entire solution, or individual parts of a solution.

While specific rules are listed below, our over-arching rule for collaboration is:

#### The Golden Rule of Collaboration

Your submitted work must represent *your own* understanding in *your own* words, regardless of collaboration.

**Acknowledging collaboration:** In all cases where collaboration has occurred, you must clearly state the name(s) of the person(s) you collaborated with on any relevant problems.

**Specific academic honesty expectations:** The following are guidelines for avoiding plagiarism in course assignments. The list is intended to be helpful but not exhaustive. If you are unsure about the appropriateness of some form of assistance on an assignment, you should always ask me.

- Every sentence that you write should be one that you have generated yourself and that you fully understand. While you are permitted to collaborate on big ideas for problems with classmates, you must work alone when writing your solutions. All collaboration with individual problems must occur with students in this section of this class who are currently at the same stage of the problem solution as you. Here are two illustrative examples. Keep in mind that these do not cover all situations:
  - You have not made any individual progress on a problem. You ask several different students in class, “How did you do the direct proof portfolio problem” until you find someone who has completed the problem and is willing to describe a route to the solution. **This is plagiarism**, because the work is not your own.
  - You have not made any individual progress on a problem. Together with a peer who also has not started the problem, you attempt to work out a route to the solution on a whiteboard. **This is fine** – as long as you respect the Golden Rule.
- **Outside resources:** On all assignments, unless directly stated otherwise, the only external resources you may use are our course textbook and your class notes. You are not permitted to go looking for completed solutions to problems in other texts or resources. You may look up relevant material from previous courses (such as a reminder of the product rule from Calculus), in which case you must explicitly cite the book and specific pages you used. Internet resources are completely off limits. If you see a full solution, there is essentially no way that you can claim to have an original solution. Evidence of using internet sources in your work will result in a minimum penalty of a score of 0 on the assignment.
- **Copying:** Copying a solution, or any part of a solution, from any source (friend, internet, book, etc.) in any setting, constitutes plagiarism.
- **Past students:** On any assignment, basing your work on the efforts of another student who previously completed this course,

Consult university policies ([CWUP 5-90-040\(22\)](http://www.cwu.edu/resources-reports/cwup-5-90-040-22)), [CWUR 2-90-040\(22\)](http://www.cwu.edu/resources-reports/cwur-2-90-040-22), and [WAC 106-125-020](https://apps.leg.wa.gov/wac/default.aspx?cite=106-125-020)) for student conduct, cheating, plagiarism, and other academic expectations. CWU's policies and recommendations for academic misconduct will be followed, leading to disciplinary action up to and including failing the course. Peers who willingly assist others in acts of plagiarism are equally guilty, and will suffer similar penalties. I reserve the right to discuss the nature and origins of any assignment with any student prior to recording any marks.

**A positive note:** Remember that I want you to be successful. That is, I want you to develop a deep, personal understanding of the material we study so that you become a better student of mathematics who can go on to do well in all of your future endeavors. Every part of this course structure is intended to help you with this. You will often struggle, and that's intentional – struggle (and eventual success!) is essential to learning.

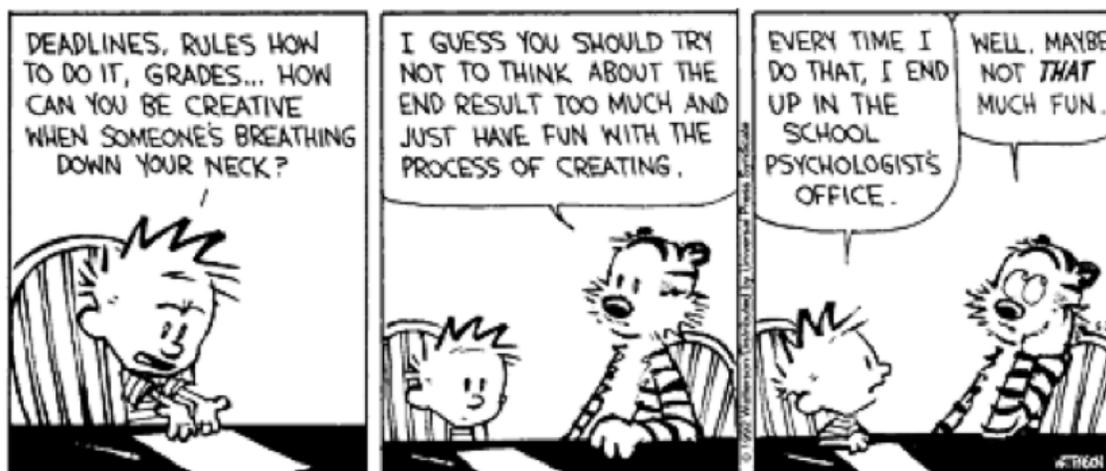
In all aspects of the course, please understand that I am always willing to discuss problems with you. I will never simply give you an answer, but I will offer direction and guidance that will assist you in coming up with a solution on your own. This is by far the most satisfying way to solve a problem, and the difficulty is well worth it. You are always welcome to discuss your questions or concerns with me at any time.

## Disability Support Services

Central Washington University is committed to creating a learning environment that meets the needs of its diverse student body. Students with disabilities should contact Disability Services to discuss a range of options to removing barriers, including accommodations: Hogue Hall 126, 509.963.2214, [DS@cwu.edu](mailto:DS@cwu.edu).

## Changes

I reserve the right to amend, adjust, or otherwise modify the syllabus at any time during the course.



## Footnotes

1. Taken/adapted from 2015 CUPM Curriculum Guide to Majors in the Mathematical Sciences. Zorn, P. (Ed.). (2015). Mathematical Association of America.
2. Carlson, M. P., & Bloom, I. (2005). The cyclic nature of problem solving: An emergent multidimensional problem-solving framework. *Educational studies in Mathematics*, 58(1), 45-75.
3. Savic, M., Karakok, G., Tang, G., El Turkey, H., & Hancock, E. (2017). Formative assessment of creativity in undergraduate mathematics: Using a creativity-in-progress rubric (CPR) on proving. In *Creativity and Giftedness* (pp. 23-46). Springer, Cham.
4. Taken/adapted from David Clark at Grand Valley State University.

## Course Summary:

| Date             | Details   |             |
|------------------|---|-------------|
| Wed Jan 8, 2020  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/777851">Day 02 Preparation - Section 1.1</a><br>( <a href="https://canvas.cwu.edu/courses/64091/assignments/777851">https://canvas.cwu.edu/courses/64091/assignments/777851</a> )   | due by 10am |
| Thu Jan 9, 2020  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/778451">Day 03 Preparation - Section 1.1</a><br>( <a href="https://canvas.cwu.edu/courses/64091/assignments/778451">https://canvas.cwu.edu/courses/64091/assignments/778451</a> )   | due by 10am |
| Tue Jan 21, 2020 |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788846">Mastery Exam 1A: Statements and Logical Reasoning - Part 1</a><br>( <a href="https://canvas.cwu.edu/courses/64091/assignments/788846">https://canvas.cwu.edu/courses/64091/assignments/788846</a> )               | due by 11am |
| Mon Jan 27, 2020 |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788876">Mastery Exam 1B: Statements and Logical Reasoning - Part 2</a><br>( <a href="https://canvas.cwu.edu/courses/64091/assignments/788876">https://canvas.cwu.edu/courses/64091/assignments/788876</a> )               | due by 11am |
| Mon Feb 3, 2020  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788877">Mastery Exam 1C: Statements and Logical Reasoning - Part 3</a><br>( <a href="https://canvas.cwu.edu/courses/64091/assignments/788877">https://canvas.cwu.edu/courses/64091/assignments/788877</a> )               | due by 11am |
| Mon Feb 10, 2020 |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788878">Mastery Exam 2A: Constructing and Writing Proofs in Mathematics - Part 1</a><br>( <a href="https://canvas.cwu.edu/courses/64091/assignments/788878">https://canvas.cwu.edu/courses/64091/assignments/788878</a> ) | due by 11am |
| Tue Feb 18, 2020 |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788879">Mastery Exam 2B: Constructing and Writing Proofs in Mathematics - Part 2</a><br>( <a href="https://canvas.cwu.edu/courses/64091/assignments/788879">https://canvas.cwu.edu/courses/64091/assignments/788879</a> ) | due by 11am |

| Date             | Details  |                |
|------------------|--|----------------|
| Sun Feb 23, 2020 |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788732">Portfolio: Direct Proof (https://canvas.cwu.edu/courses/64091/assignments/788732)</a>  | due by 11:59pm |
|                  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788782">Portfolio: Proof by Contrapositive (https://canvas.cwu.edu/courses/64091/assignments/788782)</a>                                       | due by 11:59pm |
|                  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788798">Portfolio: Proof of a Biconditional Statement (https://canvas.cwu.edu/courses/64091/assignments/788798)</a>                            | due by 11:59pm |
| Mon Feb 24, 2020 |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788880">Mastery Exam 2C: Constructing and Writing Proofs in Mathematics - Part 3 (https://canvas.cwu.edu/courses/64091/assignments/788880)</a> | due by 11am    |
| Sun Mar 1, 2020  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788784">Portfolio: Proof by Contradiction (https://canvas.cwu.edu/courses/64091/assignments/788784)</a>  | due by 11:59pm |
|                  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788783">Portfolio: Proof using Cases (https://canvas.cwu.edu/courses/64091/assignments/788783)</a>   | due by 11:59pm |
| Mon Mar 2, 2020  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788881">Mastery Exam 2D: Constructing and Writing Proofs in Mathematics - Part 4 (https://canvas.cwu.edu/courses/64091/assignments/788881)</a> | due by 11am    |
| Mon Mar 9, 2020  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788896">Mastery Exam 3A: Proof in Context - Part 1 (https://canvas.cwu.edu/courses/64091/assignments/788896)</a>                               | due by 11am    |
| Fri Mar 13, 2020 |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788897">Mastery Exam 3B: Proof in Context - Part 2 (https://canvas.cwu.edu/courses/64091/assignments/788897)</a>                               | due by 11am    |
| Sun Mar 15, 2020 |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788797">Portfolio: Proof by Induction (https://canvas.cwu.edu/courses/64091/assignments/788797)</a>   | due by 11:59pm |
| Wed Mar 18, 2020 |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788799">Portfolio: Final Reflection (https://canvas.cwu.edu/courses/64091/assignments/788799)</a>  | due by 10am    |
|                  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/790932">Day 04 Preparation - Section 1.2 (https://canvas.cwu.edu/courses/64091/assignments/790932)</a>                                       |                |
|                  |  <a href="https://canvas.cwu.edu/courses/64091/assignments/788450">Roll Call Attendance (https://canvas.cwu.edu/courses/64091/assignments/788450)</a>   |                |