CAS New Course Proposal Form

Preparer(s)

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Section I. CAS Course Proposal Cover Sheet

Department/Program: Mathematics

Effective year and term for implementation of action: [2015]Fall

New Course Information

Prefix:	Number:	Credits:
MATH	380	3

Catalog Title :Research Methods (45 character limit including spaces)

Transcript Title : Research Methods (17 character limit including spaces)

Division: ☑ Undergraduate Only ☐ Undergraduate/Graduate ☐ Graduate Only

Liberal Education (LE) Core Learning Outcome Designation(See Appendix A)

Knowledge	☐ K1	☐ K2	☐ K3	☐ K4
	☐ Meets K1 or K2 Laboratory Science Requirement			
Skills	☐ S1	☐ S2	☑ S3	
Responsibility	☐ R1	☐ R2	☐ R3	
Integration	☐ I1			

Designated for LE Core Requirement of:

☐ University Writing

☐ University Mathematics/Statistics

☐ University Race, Class, Gender and/or Sexuality Equity

☐ Cultural Diversity (see Appendix C) 0credit(s)

☐ University Service-Learning (see Appendix D) ☐ half (15 hours) credit ☐ full (30 hours) credit

☐ associated with all sections

☐ associated with and available in only some sections

☐ an option available to students in this course

GE Categorization:

GE I	○ A	○ B	○ C				
GE II	○ A	○ B	○ C	○ D	○ E	○ F	☐ meets GE II lab requirements
GE III	○ A	○ B	○ C	○ D	○ E	○ F	○ G
GE IV	○ A	○ B	○ C	○ D	○ E		
GE V	○						
Not for GE	◉						

Other Designation(s):

☐ Foreign Culture (see Appendix F)

☐ Wellness (see Appendix G) ☐ Wellness Theory 0 credit(s) ☐ Physical Activity 0 credit(s)

Course Components:

Lecture/Discussion:	Lab:	Studio:	Seminar:	Separate Discussion Section:
3				
Practicum:	Independent Study:	Other:		

Grading Basis

☑ All Grades ☐ A-F Only ☐ No Audit ☐ No S/U ☐ S/U only

Catalog Description:

Introduction to research methods in mathematics. Topics include: background research, methods of proof, mathematical writing, and

presentation skills.

When Offered? ☐ Fall ☐ Winterim ☑ Spring ☐ Summer ☐ Other:
How often? ☑ Yearly ☐ Odd Years ☐ Even Years ☐ Other:
Repeatable for credit? ☑ No ☐ Yes repeatable for a maximum of 0 credit(s)
Special Course Fees? ☑ No ☐ Yes the fee is
Cross-Listed? ☑ No ☐ Yes With
Field Trips? ☑ No ☐ Yes If so, are they required? ☐ No ☐ Yes

Registration for this course is restricted by the following:

☑ Prerequisite course(s) Math 324 or consent of instructor
☐ Co-requisite course(s):
☐ No credit if taken after:
☐ Required school/status:
☐ Declared major/minor:
☐ Required classification:
☐ Required GPA:
☐ Consent required:
☐ Other restrictions:

Section II. Justification for Course Information

A. The rationale for the presence of the prerequisite(s) is

The prerequisite for the course will be Math 324: Linear Algebra and Matrix Theory. This is the course where students are first introduced to abstract thinking which involves proofs, vector spaces, and linear transformations, as well as where they begin to appreciate the beauty of mathematics.

The students may also be eligible for the course if they receive faculty permission or recommendation based on previous or concurrent research, independent/directed studies or previous coursework. The student must demonstrate the mathematical sophistication that they would gain in Linear Algebra in their other research work.

B. The rationale for the restriction(s) is

Section III. Course Content/Approach

A. Describe the purpose(s) of the course. What is the course trying to accomplish?

This course is an introduction to research in mathematics that will prepare the students for student/faculty research collaboration at UWEC, prepare them for the rigors of graduate study in mathematics, and equip students with skills that will aid in careers in academia or industry.

This course will incorporate and teach key components of how to successfully do research, focus on building skills necessary for conducting original research as well as methods to disseminate results. These skills will include presentation and writing, surveying papers to find background information, collaborating with others, and initiating and maintaining a research program.

B.1. The name and nature of courses that significantly duplicate content of this course are

n/a

B.2. The results of the consultation were

C. The proposed class size is 20 because

of the instructor's limited time and resources. The instructor will be selecting a collection of undergraduate research papers for the students to choose from and mentoring research projects for all of the students.

D. The weightings used for evaluation of the course requirements are:

Examinations	10%	
Final Examination	0%	
Class participation	10%	
Papers	30%	
Assignments	10%	
Other	40%	Specify: Final Research Project and Presentation

E.1. Topical Outline and Timetable (15 weeks)

Writing and understanding proofs (e.g. mathematical induction, proof by contradiction, direct proof, and proof by contrapositive) 3-6 days

Computer algebra systems (e.g. Sage, Maple, Mathematica) 0-3 days

Discuss survey papers for background information, online resources, and databases 1-3 days

Discuss how to give research presentations 3-5 days
Student research presentations

Paper writing to disseminate results
LaTex and ShareLatex (collaborations) 3 days

Research Projects Total 18 days
Students will select from a provided list of undergraduate co-authored papers. They will interpret and understand results, formulate research questions, and supplement given information with needed background. Pair students with student mentors/faculty members.* 3-6 days

Work on research projects, collaborate with mentors*, bi-weekly presentations of current progress 12-15 days

Final Research Projects and Presentations Total 12 days

Work on Final Research Projects 9 days

Options for Projects
- **Original piece of work that is 3-5+ pages**
- **3-5+ page proposal for a potential research project**
- **Project decided/approved by instructor**

Presentations of Final Research Project to class 2 days

Research Colloquium (UWEC math department and STEM community) 1 day

Assessment 0-2 days

Total: 37-55 days

***Student mentors may be used for this course dependent on instructor need and availability**

E.2. Required Readings/Media Resources (Author(s), title, year of publication)

Dependent on student research projects.

F. To earn graduate credit, graduate students enrolled in this course will

n/a

G. Faculty or academic staff who will be teaching this course are

Carolyn Otto
Manda Riehl
Ursula Whitcher
Dandrielle Lewis
Michael Penkava

H. Online, hybrid, and web-enhanced courses.

Will this course be offered in an entirely online or a hybrid delivery mode?

- (•) No (Go to the next section)
- ( ) **Yes, entirely online (Respond to the following questions)**
- ( ) **Yes, hybrid (Respond to the following questions)**

Section IV. Applying for Inclusion in the LIBERAL EDUCATION CORE

☐ Not Applicable

A. This course addresses the following Liberal Education Core Learning Outcome(s) (check all that apply):

Knowledge	☐ K1	☐ K2	☐ K3	☐ K4
Skills	☐ S1	☐ S2	☑ S3	
Responsibility	☐ R1	☐ R2	☐ R3	
Integration	☐ I1			

B. Provide the requested information for each identified learning outcome.

Skills 3 (S3): Create original work, perform original work, or interpret the work of others.

1. Describe the content of the experience and especially the relationship between the content and the identified learning outcome. If it is appropriate, estimate the percentage of time spent in the experience on the identified outcome.

Math 380 is an introduction to research in mathematics. The course is specifically designed to train students in the skills required to conduct and share mathematical research. The entire content of this course is devoted to teaching key components of how to successfully conduct research, focus on building skills necessary for conducting original research as well as methods to disseminate results. These skills will include presentation and writing, surveying papers to find background information, collaborating with others, and initiating and maintaining a research program.

2. Describe the opportunities that the experience will offer students to meet the identified outcome. Your description can include pedagogy used, example assignments, broad discussion of the learning environment for the experience, etc.

This course will be taught in a combination of lecture, interactive lecture as well as active learning components (for example: in-class presentations, small-group activities, survey research, collaborative computer assignments). During the course the students will be writing and understanding proofs, surveying papers and articles for background information, formulating and asking relevant questions, giving presentations to a mathematical community, and writing papers and articles about original work.

3. Identify and provide a rationale for the presence of all prerequisites.

The prerequisite for the course will be Math 324: Linear Algebra and Matrix Theory or the consent of the instructor.
This is the course where students are first introduced to abstract thinking which involves proofs, vector spaces, and linear transformations, as well as where they begin to appreciate the beauty of mathematics. The students may also be eligible for the course if they receive faculty permission or recommendation based on previous or concurrent research, independent/directed studies or previous coursework. The student must demonstrate the mathematical sophistication that they would gain in Linear Algebra in their other research work.

4. Describe the student work for the identified outcome that will be collected, assessed and results submitted to the University Assessment Committee for purposes of assessment of our Liberal Education Core. Examples of student work include student papers, in-class writing, exams, field experiences, oral presentations, etc.

Be sure to refer to the outcome rubric elements in relation to the student work that will be assessed. If there are aspects of your course that align with a selected learning outcome but are not well-reflected in its rubric, provide relevant commentary.

Final Research Project and Presentation. Each student is required to complete a final research project individually or in a group of two-three students. The students have two options for capstone projects which are described below. After the project is completed the students will give a presentation on their work. Elements A (student demonstrates originality and/or creativity in the production or interpretation or work) and B (student demonstrates discipline-appropriate technique) will be assessed by the course's instructor by identifying elements A and B in the students' papers and presentations, also described below in relation to each project.

Final Research Project Option 1: Students will write an original piece of work that is 3-5+ pages. This work will be based on the papers they read for their research project. They can extend the research done in the papers, and discuss new investigations. Element A will be assessed by identifying whether the students were able to identify open problems in the research area and if they demonstrated creativity in formulating and providing solutions. Element B will be assessed by determining whether the students were able implement proper mathematical proof techniques to come up with a correct solution to their problem.

Final Research Project Option 2: Students will write a 3-5+ page proposal for a potential research project. They will address the relevance of the project and why it is interesting, the purpose of the project, and provide evidence as to why it is attainable. Element A will be assessed by identifying if the students were able to interpret background information and former research to formulate new and creative questions in the research area. Element B will be assessed by determining if the student can provide mathematical evidence to support why their open questions would be attainable for a research team to solve.

The course instructor will look at the written work as well as the presentation for the assessment.

5. Provide additional information on the learning experience such as:

- **Sample readings**
- **Topical outline and timetable**
- **Learning outcomes**
- **A brief description of the experience (300 words maximum)**

COURSE OUTLINE AND TIMETABLE:

Weeks 1 and 2: Writing and understanding proofs, surveying papers and articles for background information, formulating and asking relevant questions, giving presentations to a mathematical community, and writing papers and articles about original work are essential in becoming a successful mathematician. In the proposed course, undergraduates will gain this research experience. An introduction to the format of the course and technology will be discussed within the first week. During the remainder of the first week, students will be evaluated on their knowledge of proofs, and based on this evaluation, the students will be given two options as to what they will learn during the remainder of week one and all of week two. It is expected for students to give a 5 minute presentation of an application demonstrating what they learned at the end of week two, focusing on both verbal and written explanations. These presentations will be evaluated by the faculty.

Option 1: Students will polish their skills in writing and understanding proofs. Particularly, they will develop and apply proof writing techniques, and demonstrate their knowledge of mathematical induction, proof by contradiction, direct proof, and proof by contrapositive.
Option 2: Students will learn how to use Computer Algebra Systems. Particularly, they will learn how to use Sage or Maple. Sage and Maple are mathematics software systems used to typeset mathematical expressions, create embedded graphics, and to study elementary and advanced, pure and applied mathematics.

Weeks 3 and 4: During weeks three and four, we will discuss research, the importance of surveying papers for background information, online resources and databases that will be helpful during this process, and how to give a mathematics presentation. The students will then be given an assignment to find a specific paper and give a presentation on their experience that includes explaining and describing known results and their approach to the selection of their paper.

Week 5: During week five of the proposed course, students will learn the importance of writing a paper to disseminate original work and the importance of making contributions to the mathematical community. They will also learn how to use LaTex, a mathematics typesetting software mathematicians use to write

professional papers and articles. To encourage scholarly collaboration, students will learn how to use ShareLaTex, a LaTex editor that allows collaborators to access, update, and view the same document online. As society is moving toward ``cloud drives'' to protect digital content and to prevent losing memory and important documents, using ShareLaTex for mathematics collaborations is advantageous.

Week 6: During week six of the proposed course, students will choose an area specific paper as a month long research project and will be paired with a peer mentor**. During this time, students will discuss the selections of papers with peer mentors** and the instructor. For the research project students will be expected to interpret and understand results, formulate research questions, collaborate with peer mentors, and supplement given information with needed background information.

**peer mentors may or may not be used depending on the availability of students and need of the instructor.

UWEC math professors will select 20-25 undergraduate co-authored papers from Algebra and Number Theory, Topology, Analysis, Graph Theory, Combinatorics, and Actuarial Science journals.

Weeks 7-10: During weeks seven through ten, students will work on their month long research project, collaborate with their mentors, and continue to meet weekly with their mentors to discuss their progress and ask questions. As a research mathematician, meeting in-person to collaborate on a project provides opportunities for the constant flow and interchanging of ideas, writing, and professional interaction. Area specific faculty and peer mentors will attend the presentations during this month to critique, review, and provide feedback and suggestions to the students.

Weeks 11-13: After completing their research project, students will spend weeks eleven through thirteen on their final research projects, which will include either explaining and describing original research or designing a research proposal. Students will identify a faculty mentor in the area of interest; two or three students with shared research interests may collaborate on a project. The students will have two options for the capstone project as outlined in B-4 which will be used for the assessment.

Week 14: All final research projects will be presented during the fourteenth week of the course. The first two class meetings will allow the students to practice their final research project presentations in front of an audience. A special colloquium will be held on the final day. This special colloquium will be hosted by the mathematics department at UWEC. Members the mathematics department will attend as well as encourage all members of the STEM community to attend and students will deliver final research project presentations.

COURSE DESCRIPTION and LEARNING OUTCOMES:

Math 380 is an introduction to research in mathematics that will prepare the students for student/faculty research collaboration at UWEC, prepare them for the rigors of graduate study in mathematics, and equip students with skills that will aid in careers in academia or industry. This course will incorporate and teach key components of how to successfully do research, focus on building skills necessary for conducting original research as well as methods to disseminate results. These skills will include presentation and writing, surveying papers to find background information, collaborating with others, and initiating and maintaining a research program.

6. Considering existing department/program resources, please provide answers to the following:

How many sections of the experience will be offered in the fall semester? 0

How many sections of the experience will be offered in the spring semester? 1

What will be the average size for each section of the experience? 20

Section V. Applying for GENERAL EDUCATION Designation

☑ **Not Applicable**

Section VI. Applying for CULTURAL DIVERSITY Designation

☑ **Not Applicable**

Section VII. Applying for SERVICE-LEARNING Designation

☑ **Not Applicable**

Section VIII. Applying for INTERDISCIPLINARY STUDIES (Idis) Designation

☑ **Not Applicable**

Section IX. Applying for FOREIGN CULTURE Designation

☑ **Not Applicable**

Section X. Applying for WELLNESS THEORY Designation

☑ **Not Applicable**

General Notes and Comments:

Attachments

Date of Department/Program Approval (Include all department/program names and approval dates as appropriate):

Approved by department curriculum committee on Sept 25, 2014
Approved by mathematics department on Sept 30, 2014

College Curriculum Committee or Equivalent Action:

10/30/2014 ◉ Approved ○ Denied

University Liberal Education Committee Action:

○ Approved ○ Denied