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## MSE 396 – Introduction to Research

Fall 2023

Instructor: Prof. Nancy Sottos

Lecture: W 5:00-6:20 PM (see calendar for schedule)

Meeting/Contact Hours: One 80-minute lecture per week, plus guided research work.

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<b>Office Hours:</b>	by appointment – contact <a href="mailto:emalloch@illinois.edu">emalloch@illinois.edu</a> to schedule
<b>Course Website:</b>	Canvas

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### Course Credit

Students register for 3 hours of credit the first time they take this course. The course can be repeated for 1 - 3 credit hours. If the student's safety and ethics trainings have been completed in the past year, they do not need to repeat these trainings.

### Credit Toward Graduation

Students outside of the biomaterials focus area may use up to three hours of MSE 396 for "Technical Elective" credit in Materials Science and Engineering. Additional credit in MSE 396 may be used for free elective credit.

### Recommended Text

- *Research Methods for Science*, Cambridge University Press, M. P. Marder, 2011

Other texts on reserve at Grainger Library or available in electronic format are listed below. (The titles of texts available in electronic format are hyperlinked to the source.)

- *Scientific Writing and Communication: Papers, Proposals, and Presentations*, Oxford University Press, Angelika H. Hofmann, 2010
- [Scientific Papers and Presentations](#) [electronic resource], Academic Press, Martha Davis, 2013
- [Style and Ethics of Communication in Science and Engineering](#) [electronic resource], Morgan & Claypool Publishers, J.D. Humphrey and J.W. Holmes, 2009
- *An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements*, University Science Books, J.R. Taylor, 1997
- [Introduction to Probability and Statistics for Engineers and Scientists](#) [electronic resource], Academic, S.M. Ross, 2009
- *Small Message, Big Impact: How to Put the Power of the Elevator Speech Effect to Work for You*, Greenleaf Book Group Press, T.L. Sjodin, 2012
- [Presenting to Win](#) [electronic resource], Prentice Hall, J. Weissman, 2010.

## Class Description and Objectives

Students must be involved in research during the semester they are enrolled in MSE 396. The student's research activities are not limited to faculty in the Materials Science and Engineering department. The MatSE faculty recognize that Materials Science and Engineering is an important area of research within other departments and therefore Materials Science and Engineering students conducting research with faculty in other departments are allowed to register for this course.

The fundamental tenets of research will be covered, including an introduction to laboratory safety, the ethical conduct of research, constructing a hypothesis and the design of experiments to test the hypothesis. Exposure to the basic procedures comprising engineering communication and the importance of clear and concise verbal and written communication will be emphasized. Students will be required to give an elevator talk in class and give a research talk at the end of the semester. During the semester students will also have several written assignments.

Students will be introduced to the scientific method of research and the development of a hypothesis for their individual research project and how to test their hypothesis. The ability to develop a hypothesis is of fundamental importance in conducting research and the development of a research program. A hypothesis is of no use if it is not testable, to this end the student will be expected to develop reasonable experiments/simulations to test the hypothesis and have a full understanding of the data to be collected from the experiments/simulations and how this data will test the hypothesis.

The safe conduct of research is a requirement in all institutions, industrial, government, and universities. The section on laboratory safety has been developed in conjunction with the Division of Research and Safety on campus at University of Illinois, Urbana-Champaign. The safety section concludes with an online safety exam that the student must complete with a satisfactory grade and hand in the certificate that demonstrates that the online training was completed in a satisfactory manner. **It is not possible to pass this course without completing the laboratory safety training.**

Ethical training is now a requirement by funding agencies, including the National Science Foundation, which has rules governing the Responsible Conduct of Research. The section on the ethical conduct of research requires that the student complete the online ethical training. **It is not possible to pass this course without completing the ethics training.**

Students will be introduced to the process of writing and publishing a research paper. Lectures will summarize the different sections of a research paper and the style of writing each section and the relevant information to be included in each section.

Finally, an introduction to the concepts of error analysis, statistical analysis and mathematical modeling of data are discussed. The basics of statistical analysis of data are introduced, including the process of determining error bars for data and fitting of data with mathematical functions.

## Grading Policies

Student learning and growth will be assessed based on the following:

## Grading Breakdown

Research (grade provided by faculty overseeing research)	70%
Course work	10%
Literature Review	10%
Final Presentation	15%

*If you are taking this course for less than 3 credits, the final presentation will count as 25% of your grade, and you won't have to complete the literature review.*

### • Laboratory Research Work

- The major component of the course grade will come from this segment of the course.
- The faculty member overseeing the research will assign this portion of the grade.

### • Course Work

- ***It is not possible to pass this course if you neglect the lecture segment of the course.***
- ***All assignments must be typed.***
- There will be approximately 8 assignments throughout the semester.
- These homework assignments are designed to teach the fundamental tenets of research.
  - The Elevator Talk.
  - Complete the general segment of the online safety training and any additional safety training relevant to your research and turn in the certificates.
    - **It is not possible to pass this course without completing the safety training.**
  - Complete the online ethics training and turn in the certificate.
    - **It is not possible to pass this course without completing the ethics training.**
  - Write your hypothesis and experimental approach.
  - Create an outline for a research paper.
  - Write an introduction and literature review to a research paper.
  - Final presentation.

### • Final Presentation

- You will be expected to give a presentation on your research to the class.
- This talk will be 15 minutes in length.
  - 12 minutes for the presentation.
  - 3 minutes for Q & A.
  - The format for this talk will follow that given in lecture.
- The date of your talk will be scheduled for the last week or weeks of the semester. With the specific date being set during the semester. The number of days for final presentations will be determined by the size of the class.

- **Introduction and Literature Review**

- The paper is to be ~4 pages in length with at least 10 scientific journal references.
- The paper is to follow the standards laid out during the lecture on publishing your research.

### **Late Assignments**

- **No late homework assignments will be accepted unless prior arrangements are made with the instructor for valid excuses.**
  - Valid excuses include, but are not limited to, deaths in the family, jury duty, and hospitalization for illness, etc.
  - Non-valid excuses include, but are not limited to, oversleeping, “my printer didn’t work,” “I wasn’t here when you assigned it,” etc.
- If you have concerns, I am happy to discuss your specific situation with you and clarify any questions you have.

### **Academic Code of Conduct**

- This course will execute a “zero-tolerance” policy concerning cheating and plagiarism.
- Students are referred to the University of Illinois, Urbana-Champaign Student Code for completed details on the Student Code. Special attention should be given to Part 4 of Article 1 (<http://admin.illinois.edu/policy/code/>).
- Cheating and plagiarism will be dealt with according to established campus policy. Students caught cheating will receive a failing grade.

**Proposed Calendar** – Subject to adjustment and change as the class develops

Class Date		Class Topic	Assignments	Assignments Due
Wed.	Aug 23	<b>No class</b>		
Wed.	Aug 30	<b>Introduction, Safety</b>	HW 1: Lab Safety Training	
Wed.	Sep 06	<b>Ethics</b>	HW 2: Ethics	HW 1
Wed.	Sep 13	<b>The Scientific Method</b>	HW 3: Describe your hypothesis	HW 2
Wed.	Sep 20	<b>Scientific Presentations - 1</b>	HW 4: Elevator talk	HW 3
Wed.	Sep 27	<b>No Class</b>		
Wed.	Oct 04	<b>In-class Elevator Talks</b>	HW 5: Revised Elevator talk	HW 4 (in class)
Wed.	Oct 11	<b>Revised Elevator Talks</b>		HW 5 (in class)
Wed.	Oct 18	<b>Elements of the Research Paper</b>	HW 5: Write an Introduction and Lit Review	
Wed.	Oct 25	<b>No class</b>		
Wed.	Nov 01	<b>No class</b>		
Wed.	Nov 08	<b>Scientific Presentations - 2</b>	HW 6: Prepare 15 min presentation	
Wed.	Nov 15	<b>No class</b>		HW 5
Wed.	Nov 22	<b>No Class Thanksgiving</b>		
Wed.	Nov 29	<b>No Class MRS</b>		
Wed	Dec. 6	<b>Presentations - I</b>		HW6
	TBD	<b>Presentation - II</b>		HW6