
MSE 396 – Introduction to Research

Fall 2019

Instructor: Pascal Bellon

(Syllabus and presentation materials originally prepared by Dr. Matt Sherburne)

Lecture: 4101 MSEB, W 5:00-6: 20 PM

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

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1304 W. Green St.
Urbana, IL 61801
Office Hours: by appointment
Course Website: Compass

Course Credit

3 hours of credit is normal for this course, however 1 or 2 hours of credit is possible if the course is being repeated after having been satisfactorily completed and with the consent of instructor. If the student's safety and ethics training has been completed in the past year they do not need to repeat this)

Credit Toward Graduation

Students outside of the biomaterials concentration may use up to three hours of MSE 396 for "Technical Elective" credit in Materials Science and Engineering. Additional credit in MSE 396 may only be used for free elective credit. This course may be taken S/U but in that case, the course may only be used as 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 Materials Science and Engineering 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. In addition, the students will be exposed to the basics of mathematical modeling and statistical analysis of data, including the analysis of their research data. 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, then speak to engineering company representatives at one of the recruitment fairs and finally give a research talk at the end of the semester. During the semester you will be required to perform several written assignments, which will pertain to the final research paper.

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 a 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. Soon it will not be possible to seek funding if you do not have ethical training in place. Unethical behavior means that researchers throughout the world cannot trust your reported results. If you do not conduct your research ethically then you will waste other researchers time and resources as they attempt to confirm your results. 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.**

The student will be introduced to the process of writing and publishing a research paper. This is done from a historical perspective, giving an understanding of the development and importance of publishing your research, as well as an understanding of the current state of journals in the Materials Science and Engineering community. This review of journals important to the Materials Science and Engineering community includes a discussion of the review process, what the impact factor of a journal means and why you care about it. Then the students are walked through the sections of a research paper and the style of writing each section and the relevant information to be included in each section. Finally the submission process and the ethics of publishing are covered.

Finally, an introduction to the concepts of error analysis, statistical analysis and mathematical modeling of data are discussed. The topic of systematic error versus random error will be covered, including sources for each type of error and how they might be minimized. Then the basics of statistical analysis of data are introduced, including the process of determining error bars for data. The students are introduced to the concept of mathematical modeling and fitting of data with mathematical functions as well as order of magnitude and dimensional analysis. It is expected that statistical, error and mathematical modeling techniques will be performed on research data and for the generation of publication quality figures that will be used for their presentation and final paper.

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%
Final Presentation	10%
Final Paper	10%

**in the case that you are taking this course for less than 3 credits either the final paper or the final presentation will count as 20% of your grade, and you won't have to complete both assignments.*

• 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.
 - Write an introduction to your research paper.
 - Statistics, Error Analysis.
 - Final presentation.
 - Final Paper.

- **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.

- **Final Paper**

- The Final paper is due the last day of final exams by 5 PM; submit through the Compass website.
- The paper is to be 5 pages in length, with all of the relevant sections of a research paper submitted for publication.
- The paper is to follow the standards laid out during the lecture on publishing your research or the final paper write-up that can be found on Compass.

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 Activity	Assignments	Assignments Due
Wed.	28-Aug.	No class		
Wed.	4-Sept.	No class		
Wed.	11-Sept	Safety	HW#1: Safety	
Wed.	18-Sept.	No class	HW#2: Elevator talk	HW#1
Wed.	25-Sept.	Elevator Talks	HW#3: Revised Elevator talk.	HW#2 (in class)
Wed.	2-Oct.	Elevator Talks		HW#3 (in class)
Wed.	9-Oct.	The Scientific Method	HW#4: Describe your Hypothesis	
Wed.	16-Oct.	No Class		HW#4
Wed.	23-Oct.	Elements of the Research Paper	HW#5: Write the Introduction to your paper	
Wed.	30-Oct.	Ethics	HW#6: Ethics	HW#5
Wed.	6-Nov.	No Class		HW#6
Wed.	13-Nov.	No Class		
Wed.	20-Nov.	No Class		
Wed.	27-Nov.	No Class – Thanksgiving Break		
Wed.	4-Dec.	Presentations		
Wed.	11-Dec.	Presentations		
Frid.	20-Dec.	Final Paper Due		Final Paper Due: 5 PM (submit to compass)