MARYLAND APPLIED GRADUATE ENGINEERING

ENPM 808J
Fall 2022

Course Syllabus (as of 08/29/2022)

ENPM 808J: (0101, SY01) Advanced Topics in Engineering Design of Experiments (DOE)

Learning Outcomes

The course objective is to learn how to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions. Both design and statistical analysis issues are discussed. Opportunities to use the principles taught in the course arise in all phases of engineering work, including new product design and development, process development, and manufacturing process improvement. Applications from various fields of engineering (including chemical, mechanical, electrical, materials science, industrial, etc.) will be illustrated throughout the course. Computer software packages (JMP Software from SAS) to implement the methods presented will be illustrated extensively, and you will have opportunities for learning reinforcement and examinations for mastery. All experiments conducted by engineers and scientists are designed experiments; some of them are poorly designed, and others are well-designed. Well-designed experiments allow you to obtain reliable, valid results faster, easier, and with fewer resources than with poorly designed experiments. You will learn how to plan, conduct, and analyze experiments efficiently in this course. A well-designed experiment can lead to reduced development lead time for new processes and products, improved manufacturing process performance, and products that have superior function and reliability.

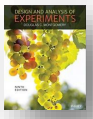
After successfully completing this course you will be able to:

- Create your own Engineering Design Experiments
- Understand Key Interactions in Processes
- Perform simple Single Factor Comparative Experiments
- Leverage Robust Engineering Approaches
- Perform complex (2K and 3K) Factorial Experiments
- Comprehend Regression and Response Surface Analysis
- Determine DOE Applicability and Uses within multiple Industries

Focused Resources

- **Course website:** UMD Canvas ENPM 808J
- **Text:** (https://umcp.bncollege.com/shop/umcp/home)

Lectures will be elaborated from the following text.



Design and Analysis of Experiments
Douglas C. Montgomery (Montgomery)
Ninth edition (2017).
ISBN: 978-1-119-11347-8

Design of Experiments for Engineers and Scientists
Jiju Antony (Antony)
Second edition (2009).
ISBN: 978-0-08-099417-8

Dr. Tony D. Barber
Email: TDBarber@UMD.edu
Phone: 202-321-0834

Class Meets

Wednesday
7:00pm – 9:40pm
Format: JMP 2216

Office Hours

- ***Remote (By Phone)***
  - Format
    - By appointment only*
    - 30 min increments

*Please reserve at least 24 hours prior.

Teaching Assistants

N/A

Prerequisites

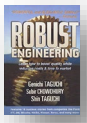
Permission of ENGR Advisor

Course Communication

All course communication will be facilitated using the Canvas Messaging on the University of Maryland (UMD) Electronic Learning Management System (ELMS)

Course Materials

Orders for Course Materials have been sent to the Book Store. I have provided links. Also, you may visit your local bookstores to obtain each text.



Robust Engineering*
Genichi Taguchi, Subir Chowdhury, Shin Taguchi (Taguchi)
First edition (2000).
ISBN: 978-0-07-134782-8

An Introduction to The Design & Analysis of Experiments*
George C. Canavos, Ioannis A. Koutrouvelis (C&K)
First edition (2009).
ISBN: 978-0-13-615863-9

*Note: This are not explicitly required but recommended if you want to learn more on DOE.

Additional Resources

- JMP Pro by SAS
  - (PC) https://terpware.umd.edu/Windows/Title/1873
  - (Mac) https://terpware.umd.edu/Mac/Title/1873

Topics Covered

- Introduction and Fundamentals of Design of Experiments (DOE)
- Systematic Methodology on how to set up Experiments
- Various approaches for simple to complex Experimentation
- Robust Parameter Design and Application (i.e. Design for Robustness and Resiliency)
- Use of Regression Analysis and Response Surface Method in complex Engineering Analysis
- Leveraging DOE in other areas such as Quality Management and Decision Analysis

Grades

Grades are not given but earned. Your grade is determined by your performance on the learning assessments in the course and is assigned individually (not curved). If earning a grade is important to you, please speak with me at the beginning of the semester so that I can offer some helpful suggestions for achieving your goal. All assessment scores will be posted on the course ELMS page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email me to schedule a time for us to meet.

The learning assignments will be on your ability to display foundational to mastery skills within the course. This course will have seven recursive learning assessments to show mastery of knowledge. Recursive meaning, each learning assessment will cover a percentage of course work from previous weeks. Learning Assessment will be provided on an establish schedule. As always, I am happy to discuss any of your grades with you, and if I have made a mistake, I will immediately correct it. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

Learning Assignments	#	Points	Total Points	Category Weight
Assessment Quizzes	5	40	200	40%
Discussion Questions	5	10	50	20%
Final Exam (Quiz 6 Extra Credit)	1	100	100	40%
Total Points			360	100%

Final Grade Cutoffs										
+	97.00%	+	87.00%	+	77.00%	+	67.00%			
A	93.00%	B	83.00%	C	73.00%	D	63.00%	F	<60.0%	
-	90.00%	-	80.00%	-	70.00%	-	60.00%			

Course Schedule (Subject to Change)

Week	Date	Topic(s)	Reading	Discussion Thread	Quiz Schedule
Week 1	8/31/2022	- Course Overview - Introduction and Fundamentals to Design of Experiments (DOE)	- Montgomery (Chapter 1) - C&K (Chapter 1) - Antony (Chapter 1 and 2)		
Week 2	9/7/2022	- Understanding key Interactions in processes - Systematic Methodology for DOE	- Montgomery (Chapter 1) - C&K (Chapter 1) - Antony (Chapter 3 and 4)		Assessment Quiz 1 (Weeks 1, 2)
Week 3	9/14/2022	- Simple Comparative Experiments - Experiments with Single Factors	- Montgomery (Chapter 2 and 3) - C&K (Chapter 2) - Antony (Chapter 5)	Discussion Question 1	Quiz 1 Due
Week 4	9/21/2022	- Robust Parameter Design - Robust Engineering Methodology	- Montgomery (Chapter 12) - Taguchi (Chapter 1, 2, and 3)		Assessment Quiz 2 (Weeks 1, 2, 3, 4)
Week 5	9/28/2022	- Randomized Blocks - Latin Squares	- Montgomery (Chapter 4 and 13) - C&K (Chapter 3)	Discussion Question 2	Quiz 2 Due
Week 6	10/5/2022	- Introduction to Factorial Designs - Application of Random Block and Latin Squares on Factorial Design	- Montgomery (Chapter 5) - C&K (Chapter 4 and 5) - Antony (Chapter 6)		Assessment Quiz 3 (Weeks 3, 4, 5, 6)
Week 7	10/12/2022	- 2K Factorial Design - Confounding in 2K and 3K Factorial Experiments	- Montgomery (Chapter 6 and 7) - C&K (Chapter 7 and 8) - Antony (Chapter 6)	Discussion Question 3	Quiz 3 Due
Week 8	10/19/2022	- Two-Level Fractional Factorial Design - Additional Design and Analysis for Factorial and Fractional Factorial Designs	- Montgomery (Chapter 8 and 9) - C&K (Chapter 9) - Antony (Chapter 6)		Assessment Quiz 4 (Weeks 5, 6, 7, 8)
Week 9	10/26/2022	- Nested and Split -Plot Designs - Repeated Measures Designs	- Montgomery (Chapter 14) - C&K (Chapter 6)	Discussion Question 4	Quiz 4 Due
Week 10	11/2/2022	- Regression Analysis - Response Surface Method	- Montgomery (Chapter 10 and 11) - C&K (Chapter 10 and 11)		Assessment Quiz 5 (Weeks 7, 8, 9, 10)
Week 11	11/9/2022	- Other Design and Analysis Topics - DOE Tips and Case Studies	- Montgomery (Chapter 15) - C&K (Chapter 8 and 9)	Discussion Question 5	Quiz 5 Due
Week 12	11/16/2022	- DOE Applicability in Industry - DOE within Quality Management / Six Sigma	- C&K (Chapter 10 and 11)		Assessment Quiz 6 (Extra Credit) (Weeks 9, 10, 11, 12)
Week 13	**11/23/2022**	**Thanksgiving Break (11/25 - 11/29)**			Quiz 6 Due
Week 14	11/30/2022	- Course Review and Q&A	N/A	N/A	N/A
Week 15	12/7/2022	- Final Exam Review / Final Exam Released	N/A	N/A	Final Exam Due (Sunday 12/11)
Week 16	12/14/2022	- No Class	N/A	N/A	N/A

Note: This is a tentative schedule, and subject to change as necessary – monitor the course ELMS page for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.

Academic Integrity:

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.studenthonorcouncil.umd.edu/whatis.html.