STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK

MASTER SYLLABUS

COURSE NUMBER – COURSE NAME
MECH 351 – Design of Experiments

Created by: Daniel Miller

Updated by:

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Department: Mechanical & Energy Technologies

Semester/Year: Fall 2018

A. **TITLE**: Design of Experiments

B. **COURSE NUMBER:** MECH 351

C. **CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)**

 # Credit Hours: 3
 # Lecture Hours: 3 **per week**
 # Lab Hours: **per week**
Other: **per week**

Course Length: 15 **Weeks**

D. **WRITING INTENSIVE COURSE**: Yes ☐ No ☒

E. **GER CATEGORY: None:** ☒ **Yes:** GER
***If course satisfies more than one*:** GER

F. **SEMESTER(S) OFFERED: Fall** ☒ **Spring** ☐ **Fall & Spring** ☐

G. **COURSE DESCRIPTION:**

This course provides methodologies that engineers, technologists, and management personnel need to plan and conduct experiments to quantify cause and effects relationships in complex systems. Design of experiments test multiple factors at one time determining whether changes to products, processes, and systems are improvements. Students will perform simple comparative experiments isolating known sources of variation; while multiple level fractional designs will allow analysis of variance (ANOVA) to predict models of interactions that optimize a process.

H. **PRE-REQUISITES: None** ☐ **Yes** ☒ **If yes, list below:**

>45 Earned Credits

CO-REQUISITES: None ☒ **Yes** ☐ **If yes, list below:**

I. STUDENT LEARNING OUTCOMES: (*see key below*)

By the end of this course, the student will be able to:

Course Student Learning Outcome [SLO]	***Program Student Learning Outcome [PSLO]***	***GER*** *[If Applicable]*	***ISLO & SUBSETS***	
1. Explain OFAT and apply statistics to isolate known sources of variation and question reliability of data			5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
2. Calculate and interpret ANOVA			5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
3. Formulate hypothesis, Ishikawa diagrams and plan experiments			2-Crit Think ISLO ISLO	Subsets Subsets Subsets Subsets
4. Design, collect and evalaute data and write report for full and fractional factorial experiments			1-Comm Skills ISLO ISLO	Subsets Subsets Subsets Subsets
5. Calculate and identify interactions and confounding patterns			5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
6. Plan, collect data and give oral report for mixture experiments			1-Comm Skills ISLO ISLO	Subsets Subsets Subsets Subsets

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KEY	**Institutional Student Learning Outcomes [ISLO 1 – 5]**
ISLO #	**ISLO & Subsets**
1	**Communication Skills** Oral [O], Written [W]
2	**Critical Thinking** *Critical Analysis [CA] , Inquiry & Analysis [IA] , Problem Solving [PS]*
3	**Foundational Skills** *Information Management [IM], Quantitative Lit,/Reasoning [QTR]*
4	**Social Responsibility** *Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]*
5	**Industry, Professional, Discipline Specific Knowledge and Skills**

*Include program objectives if applicable. Please consult with Program Coordinator

J. APPLIED LEARNING COMPONENT: Yes ☒ No ☐

If YES, select one or more of the following categories:

- ☒ Classroom/Lab
- ☐ Internship
- ☐ Clinical Placement
- ☐ Practicum
- ☐ Service Learning
- ☐ Community Service
- ☐ Civic Engagement
- ☐ Creative Works/Senior Project
- ☐ Research
- ☐ Entrepreneurship (program, class, project)

K. TEXTS:

Mark J. Anderson, Patrick J. Whitcomb. DOE Simplified: Practical Tools for Effective Experimentation, Productivity Press, 2015

L. REFERENCES:

Box, George, J., Hunter, Stuart, and Hunter, William, Statistics for Experimenters, 1978, John Wiley and Sons.

Cornell, John, Experiments with Mixtures, 2nd ed. 1990, John Wiley and Sons.

John, Peter, Statistical Design and Analysis of Experiments, 1969, Macmillan Company

Montgomery, Douglas, and Myers, Raymond, Response Surface Methodology, 1995, John Wiley and Sons.

Phillips, John, How to Think About Statistics, 2nd ed., 1982, W. H. Freeman. !

M. EQUIPMENT: None ☐ **Needed:** Technology enhanced classroom

N. GRADING METHOD: A-F

O. SUGGESTED MEASUREMENT CRITERIA/METHODS:

Tests, Homework, Project, Written Reports and Oral Presentations

P. DETAILED COURSE OUTLINE:

I. Introduction to Design of Experiments
- **A. Process improvement**
- **B. Descriptive statistics**
- **C. Confidence Intervals**
- **D. Model for improvement**

II. Simple Comparative Experiments

A. F-tests
B. Fair testing
C. Blocking known variation

III. Testing of Single Factors
A. Principles for testing
B. Two-level, one factorial design
C. Plots and interpretation of interactions
D. Modeling responses w/ predictive equations

IV. Testing of Multiple Factors
A. Principles for testing
B. Two-level, multiple factorial design
C. Plots and interpretation of interactions
D. Modeling responses w/ predictive equations

V. Response Transformation
A. Mathematical transformations
B. Choosing the right transformations

VI. Fractional Factorials
A. Examples of fractional factorials
B. Potential confusion by aliasing
C. Plackett-Burman design
D. Taguchi design
E. Irregular fractions

VII. Minimal-run designs
A. Resolution of minimal-runs
B. Fold-over of resolution III designs
C. Single factor fold-over

VIII. General Factorial Designs
A. Analyze un-replicated general factorials
B. Optimizing response surface models
C. Augmenting a central composite design
D. Mixing designs

Q. <u>LABORATORY OUTLINE</u>: None ☒ Yes ☐