MCEE 205 Statistics and Design of Experiments

ROCHESTER INSTITUTE OF TECHNOLOGY
Microelectronic Engineering

MCEE 205 Statistics and Design of Experiments

Students required to take this course: (by program and year, as appropriate)
Course is required for Microelectronic Engineering students in 2nd year.

Students who might elect to take the course:
Students interested in use of statistics and experimental design for research or manufacturing operations.

Statistics and Design of Experiments

Statistics and Design of Experiments will study descriptive statistics, measurement techniques, SPC, Process Capability Analysis, experimental design, analysis of variance, regression and response surface methodology, and design robustness. The application of the normal distribution and the central limit theorem will be applied to confidence intervals and statistical inference as well as control charts used in SPC. Students will utilize statistical software to implement experimental design concepts, analyze case studies and design efficient experiments.

Prerequisite(s): None
Co-requisite(s): None
Class 2, Lab 3, Credit 3 (Semester)

Textbook:
Quality by Experimental Design, Fourth Edition
Thomas B. Barker, Andrew Milivojevich
February 8, 2016 by Chapman and Hall/CRC
Textbook - 724 Pages - 510 B/W Illustrations
ISBN 9781482249668

Schaum's Outline of Statistics for Engineers By Larry Stephens Date April 7, 2011
Format Paperback, 304 pages Other Formats Electronic book text
ISBN 0071736468 / 9780071736466

Goals of the course:
1. To understand the nature of variability.
2. To understanding of the principles of statistical inference.
3. To apply statistical inference and control charts to applications.
4. To understand assumptions and limitations of DOE.
5. To conceive and conduct a designed experiment to characterize a process.

Topics:
1. Tools for Improving Manufacturing
2. Characteristics of a good response
3. Fundamental concepts of probability
4. Variability and how to describe it—Sampling and degrees of freedom
5. Measurement techniques and Random variation
6. The normal curve and the distributions of averages
7. Application of the Central limit theorem to Control Charts
8. Statistical Process Control and Process Capability
9. Means and standard deviations of sums and differences
10. Statistical inference about variances
11. Interval estimates for the mean
12. Test of Hypothesis of the mean
13. Testing means and variances
14. Full Factorial Design
15. ANOVA and Regression Analysis
16. Model Equations
17. Fractional Factorials and Confounding Effects
18. 3 Level Designs
19. Taguchi Methodology

Laboratory
1. JMP
2. JMP Plots
3. Understanding variability
4. SPC and Process Capability
5. One-way ANOVA
6. ANOVA on Full Factorial Design
7. Regression and Zero Point information in Factorial Designs
8. ANOVA on Fractional Factorial Design
9. Response Surface Methodology DOE Project

Evaluation Methods:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework / Labs</td>
<td>35%</td>
</tr>
<tr>
<td>Exams (2)</td>
<td>30%</td>
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<tr>
<td>Report / Presentation on DOE project</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>15%</td>
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Laboratory requirements:
This course reinforces general statistical knowledge through the collection of actual lab data. The specific data collected can change since the concepts are general. Similarly the
course allows students to use a laboratory to execute a variety of different designed experiments as generally taught in lecture. The nature of the experiment is not the focus but rather the general application of DOE concept. The lab makes use of the very unique Semiconductor & Microsystems Fabrication Laboratory within the KGCOE, i.e. “the cleanroom”.

Course Policy on Academic Honesty

KGCOE HONOR PRINCIPLES: RIT Engineering faculty, staff and students are truthful and honorable, and do not tolerate lying, cheating, stealing, or plagiarism.

All members of our community are expected to abide by these principles and to embrace the spirit they represent. We each have a responsibility to address any unethical behavior we observe; either through direct discussion with the offending party, or by discussion with an appropriate faculty or staff member. Allowing unethical behavior to continue unchallenged is not acceptable.

Rochester Institute of Technology does not condone any form of academic dishonesty. Academic Dishonesty falls into three basic areas: cheating, duplicate submission and plagiarism (refer to http://www.rit.edu/kgcoe/advising/handbook.pdf pages 19-20 for more information).

Throughout this course the following specific conditions exist in regards to academic honesty:

<table>
<thead>
<tr>
<th>Course Element</th>
<th>Specific Conditions</th>
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<tr>
<td>Homework: Graded and Ungraded</td>
<td>Student collaboration is encouraged. However, the final product that is turned in must be your own work. All homework sets must be completely documented in regards to references used (books other than the course textbook, web sites, etc.) and assistance obtained from individuals other than the course instructor. Proper documentation would include source, date, and extent of information gained through that source.</td>
</tr>
<tr>
<td>Exams</td>
<td>Individual exercise; collaboration of any kind is disallowed</td>
</tr>
<tr>
<td>Laboratory Assignments</td>
<td>All team members expected to participate fully; one submission required from each student</td>
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Any act of Academic Dishonesty will incur the following consequences. After notifying and presenting the student with evidence of such misconduct, the instructor has the full prerogative to assign a lower grade, including an "F" for the offense itself or for the entire course. If after careful review of the evidence, the instructor decides that the student's actions are indeed misconduct and warrant a penalty, the instructor will add a letter to the student's file in his or her home department (copy to the student, Department Head and the Dean) documenting the offense. Depending on the seriousness of the offense, the student may also be brought before the Academic Conduct Committee of the College in which the offense occurred, and may face academic suspension or dismissal from the Institute. The student has the right to appeal any disciplinary action as described in section D17.0 "Academic Conduct and Appeals Procedures" and D18.0 "RIT Student Conduct Process” of the Institute Policies and Procedures Manual.

Prepared by: Dale Ewbank

Date: 08/01/2017