IE 429 DESIGN OF EXPERIMENTS

Year and Semester **:** 2024-2025 Fall
Credit Hour **:** (3 0 3)
ECTS **:** 5
Prerequisite(s) **:** IE 228 Engineering Statistics

CATALOG DESCRIPTION

The place of design of experiments in quality; basic concepts such as controllable and nuisance factors, response variables, statistical vs. practical significance; full factorial designs; fractional factorial designs; application of regression analysis for analyzing factorial designs; Taguchi's robust design; response surface methodology.

REFERENCE BOOKS

- Montgomery, D.C. *Design and Analysis of Experiments (5th ed.)*, John Wiley & Sons, Inc., 2001.
- Mathews P. G. *Design of Experiments with Minitab*, ASQ Milwaukee Press, 2005.
- Boddy R. & Smith G. *Effective Experimentation for Scientists and Technologists*, John Wiley & Sons, Inc., 2010.
- Bass I. *Six Sigma Statistics with Excel and Minitab*, McGraw-Hill Companies, Inc., 2007.

COURSE OBJECTIVE

This course has the following aims:
- To introduce the concepts and methodology of experimentation.
- To develop an understanding of differences among designs.
- To develop the skill in performing, analyzing and interpreting the results of an experiment.
- To introduce the way of finding out the optimum levels of the effective factors.

LEARNING OUTCOMES

On successful completion of this course, all students will have developed the following skill set:
- Knowledge and understanding of experimentation and its applications.
- Skill in choosing and applying correct designs.
- Skill in analyzing the data obtained by experimentation and interpreting the results.
- Skill of using software for designing and analyzing experiments.
- Teamwork skills in product and/or process improvement.
- Skills in report writing.
- Awareness of ethical issues.

COURSE OUTLINE

Week	Topic(s)
1	Introduction to Design of Experiments, its relation to quality and statistical process control.
2	Basic concepts: controllable factors, response variables, nuisance factors, factor levels; experimental design and analysis steps; two-factor two-level full factorial designs, computing effects and the interaction, coding factor levels.
3	Three-factor two-level full factorial designs; concepts of interactions and practical vs. statistical significance, normal probability plots; choosing factor levels in unreplicated designs.
4	Regression approach for analysis: using regression for replicated designs, using pooling with normal probability plots and then regression for unreplicated designs, examples with MS Excel applications.
5	Four factor two-level full factorial designs; sparsity-of-effects principle; detection of experimental errors; analysis of interaction and main-effect plots; assumption of equal variances and residual plots; examples with MS Excel applications.
6	An introduction to design of experiments with Minitab package; fractional factorial designs: designs with the 2^3 principle fraction (2^{4-1}, 2^{5-2}, 2^{6-3}, 2^{7-4}), principles of Ockham's razor and Effect heredity.
7	General fractional factorial designs; resolution III, IV and V designs; defining relations and design generators; examples with Minitab.
8	A general review prior to midterm; detailed presentation and class discussion of term projects.
9	Screening vs. follow-up experiments; fold-over designs; problems with missing data and inaccurate factor levels; examples with Minitab.
10	An introduction to robust designs: nuisance factors and their effects, Taguchi's loss function, blocking vs. robust design.
11	Robust design when the nuisance factors are unknown: replications for variance calculations. Examples with MS Excel and Minitab.
12	Robust design when the nuisance factors are known; Taguchi's approach to robust design with inner and outer arrays; where to look for nuisance variables; examples with MS Excel and Minitab.
13	Response surface methodology: method of steepest ascend and analysis of second order models.
14	Presentation of term projects and class discussions.

COMPUTER USAGE

Students will use word editing and statistical tools/programs such as MINITAB software package while doing their project.

GRADING

Assessment Item	Weight (%)
Project	25
Midterm Exam	35
Final Exam	40
TOTAL	100

LECTURE HOURS

Day	Time	Classroom
Tuesday	14.20 – 15.10	LA14
	15.20 – 16.10	
	16.20 – 17.10	

LECTURER

Tolga Temuçin, Ph.D.
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IMPORTANT NOTES

- Communication will be made through http://webonline.cankaya.edu.tr Announcements should be checked regularly. Students should check their accounts to make sure that they can access the page of IE 429 through *webonline*.
- Students should follow the lectures and study the course material regularly.
- Make-up exams are given only for students who have medical reports given (or approved) by Çankaya University Health Center. All medical excuse reports should be officially submitted within 7 working days (starting from the end-date of the medical excuse). Make-up exams will not be given for applications which are not submitted on time.
- Any sort of plagiarism will not be tolerated and disciplinary measures will be taken.