ST214 Aug 3:0

Mathematical Analysis of Experimental Data

Instructor

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Email:

Department: Center for Sustainable Technologies

Course Time:

Lecture venue: CST Lecture Hall

Detailed Course Page:

Announcements

Brief description of the course

This course is aimed at graduate students working in data analysis. As outlined in the course content, it exposes the student to collect and analyze data. It also bridges the gap of physics and mathematics giving due importance to both. The course is aimed at students pursuing graduate studies both in science and engineering streams.

Prerequisites

None

Syllabus

Instrument characteristics for popular variables like length, pressure, temperature, velocity, force, density and torque. Systematic and random errors, calibration science and corrections at different scales of instrument, dimensional analysis leading to functionalities, creation of non-dimensional groups, critical and non-critical variables governing the process. Uncertainty analysis and curve fitting; Spline generation; Probability theory, sampling data, confidence levels; Measurement Variability and zeroth, first and higher order errors; controlling and minimizing variability, replication, randomization, blocking and controls. Single factor

experiments, randomized blocks, Latin square designs, Mathematical data analysis of data distribution, normal, Chi-squared and t-distribution, confidence interval and hypothesis testing, Simple and multiple linear regressions. Mathematical analysis of experimental data from problems in fluid flow, heat transfer and combustion.

Course outcomes

At the end of the course, the student is expected to learn

1) Dimensional analysis leading to functionalities; uncertainty analysis and curve fitting

2)Simplified understanding of complex probability theories

3)Design of experiments, replication, randomization and blocking

4)Anova and screening experiments

5)First hand learning in applying the tools and skills learnt in the class room onto experimental test rigs in planning, design collection and analysis of data.

Grading policy

Mid term 1) 35%

Mid term 2) 35%

Final project Presentation 3) 30%

Assignments

Resources

a) Ernest O Doebelin, Engineering Experimentation, McGraw-Hill International
b)G. Beckwith and Lewis. N. Buck, Mechanical measurements,
c)Box, G. E. P., Hunter, W. G., and Hunter, J. S. (1978), Statistics for Experimenters: An Introduction to Design, Data Analysis, and Model Building, John Wiley & Sons. Inc. ISBN: 0-471-09315-7.
d)Jack Philip Holman, Experimental methods for engineers, (2011), McGraw-Hill Series in Mechanical Engineering, Eight Edition
e)Douglas C. Montgomery, Design and Analysis of Experiments (2012), John Wiley and Sons, Inc.