MF2024 Robust and Probabilistic Design 6.0 credits

Robust konstruktion

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for MF2024 valid from Autumn 2010

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Mechanical Engineering

Specific prerequisites

Qualified for studies in grade 3 and P: MF1038/MF1012/4F1812, MF1039/MF1013/4F1813, MF1040/MF1014/4F1814 eller M: MG1003/4G1162, MF1025/MG1004/4G1163 T: MF1015/4F1815

Design and product realization-methods/Productrealization-design/Product realization for T and MF101X/MF102X/MF104X/MF111X/MF112X/MF114X/MF1025/MF1026 and MF2018 or a Bachelor in Mechanical Engineering.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

Probabilistic design is an engineering design methodology with the aim to produce high-quality products, by systematically studying the effects of variations in the design parameters on product performance. Robust design is a methodology for optimising this quality by making the performance of the product insensitive to variations in the manufacturing, material, operational, and environmental properties.

A student that has completed the course shall be able to:

• describe the characteristic properies of various design characteristics in statistical terms,

• assess the confidence interval of the assessed reliability of a technical system,

• find the type of probability distribution for a given set of data,

• describe the purpose for, the methodology of, and the output from Design of Experiments,

• define a testplan for a set of physical and numerical experiments,

• describe the purpose and steps for performing a Monte-Carlo simulation.

• use Monte Carlo simulations to analyse how the uncertainties in a models input variables affects the results from the model;

• describe the purpose of Robust design and how it relates to optimization approaches,

• use the Robust design methodology to minimize the sensitivity of a technical response parameter to variations in a set of component design parameters,

• use the Robust design methodology to minimize the sensitivity of a technical response parameter to variations i a set of technical interaction parameters,

• use the Robust design methodology to minimize the sensitivity of an interactive response parameter to variations in a set of ergonomic parameters.

Course contents

Engineering statistics; distributions, Normal, exponetial, Weibull, confidence intervals

Design of experiments: physical and simulation experiments, suspended or censured tests

Probabilistic design; Monte-Carlo simulation (Matlab, Ansys) of performance variations caused by variations in design (manufacturing tolerances, material properies, geometric configuration), user (anthropometric data), and environmental parameters (humidity, electromagnetic fields, temperature, dust)

Robust design; minimizing performance variation due to variation in design parameters, human properties and environmental conditions

Disposition

• Twelve lectures (12 x 2 hours)

• Four laborations (4 x 2 hours)

• Two group assignments

• Two individual assignments

• A written examination

Course literature

• Handouts

• Clyde M. Creveling "Tolerance Design: A Handbook for Developing Optimal Specifications
.

Examination

• INL1 - Assignments, 3.0 credits, grading scale: P, F

• TEN1 - Written examination, 3.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

• INL1 - Individual assignment, 4.0 credits, grade scale: A, B, C, D, E, FX, F

• TEN1 - Examination, 2.0 credits, grade scale: A, B, C, D, E, FX, F

Final grading based on INL1 and TEN1 requires passed laboratory work and group assignments

Ethical approach

• All members of a group are responsible for the group's work.

• In any assessment, every student shall honestly disclose any help received and sources used.

- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.