Department of Mechanical and Industrial Engineering
University of Toronto
MIE 1727F: Statistical Methods in Quality Assurance

Instructor: Prof. V. Makis, MC223, e-mail: makis@mie.utoronto.ca

Required Textbook: D.C. Montgomery: Introduction to Statistical Quality Control, Seventh Edition, Wiley 2013 (also the sixth edition can be used).

Course Website: http://portal.utoronto.ca/

Recommended Texts:
1. R.O. Kuehl: Design of Experiments: Statistical Principles of Research Design and Analysis, 2nd Edition, Duxbury Press, 2000.
2. A. Mitra: Fundamentals of Quality Control and Improvement, Second Edition, Prentice Hall, 1998.
3. J.R. Evans and W.M. Lindsay: The Management and Control of Quality, 6th Edition, Thomson, 2005.
4. F.M. Gryna: Quality Planning and Analysis, 4th Edition, McGraw Hill, 2001.
5. C. Derman and S.M. Ross: Statistical Aspects of Quality Control, Academic Press, 1997.

Lectures: Friday, 5:10-8pm

Course Overview:

Awareness of the importance of quality has increased dramatically. Understanding and improving quality is a key factor leading to company's success and its enhanced competitive position. The course focuses on the following topics in Quality Assurance: Introduction to quality engineering, TQM, costs of quality, quality and productivity, statistical process control, process capability analysis and supplier-producer relations, quality standards and certification, six sigma philosophy and methodology, quality/process improvement using designed experiments, and an overview of acceptance sampling.

Grading:

2 Assignments	20% each	
1 Project	20%	
Final exam	40%, closed book.	

Two aid sheets of size A4 will be permitted for the final exam written on both sides. Only non-programmable calculators will be permitted for the final exam.

Lecture handouts and tutorials with solutions can be found on the course website.

Tentative Work Schedule

Week	Topic
1	Basic concepts in quality engineering. Definitions of quality. Loss functions and Taguchi's approach to quality improvement. TQM. Costs of quality. Quality and productivity. The three stages in quality assurance.
2	Introduction to acceptance sampling. Lot formation and random sampling. Producer's and consumer's risks and the OC curve. AQL-based plans for attributes and variables. MIL-STD-105E and MIL-STD 414 and their ISO equivalents. Sampling plans for continuous production. Sequential sampling. Rectifying inspection. Average outgoing quality and AOQL. Dodge-Romig AOQL and LTPD plans.
3-4	Introduction to statistical process control. The seven basic SPC problem-solving tools. Control charts for variables. The $\overline{X}$ chart with known parameters. The OC function. The run length distribution, average run length and the average time to signal. Design of the chart. Analysis of patterns and the zone rules. Controlling manufacturing processes exhibiting trends. Recent research and development in SPC.
5-6	Control charts for variables-parameters unknown. $\overline{X}$ and R charts. $\overline{X}$ and S charts. Fixed and variable sample size. Control charts for individual measurements - I and MR charts. Three sigma and probability limits.
7	Process capability analysis. Capability indexes. Confidence intervals and hypothesis testing about C_p. The natural tolerance limits. Supplier-producer relations and quality certification. ISO 9000 and ISO/TS 16949 quality standards. The six sigma quality and DMAIC methodology.
8-9	EWMA control chart. One and two-sided CUSUM charts based on sequential probability ratio test. Tabular CUSUM and V-mask. FIR CUSUM. Design of the chart.
10-11	Control charts for attributes. p, np, c, and u charts. Demerit charts. Approximations. Transformations and probability limits.
11-13	Quality improvement using designed experiments. An overview of the problems solved using DE. Factorial experiments. The 2^k factorial design. Regression model. The 2^k design with n replications. Yates' algorithm. A single replicate of the 2^k design. Plotting the effects. Hypothesis testing. Applications. The three stages in the product design. An overview of the Taguchi methods. Robust design.

Individual Course Project

The Project may be an in-depth analysis of a published case study or a research paper in the quality assurance area, or application of knowledge to a particular problem.

The report will be typed (10-15 pages), and will contain:

      a) Introduction
      b) Body
      c) Conclusion
      d) References

The project reports will be collected at the final exam.