Unidade Curricular: Advanced Techniques for Quality

Área Científica: EG
Duração: Semestral
Horas de trabalho: 162
Horas de contacto: 60
ECTS: 6

Docente Responsável: Isabel Maria da Silva João

Learning outcomes of the curricular unit
The advanced techniques for quality covers topics related to product and process design improvement. The objective is to introduce the experimental design and the types of problems in which designed experiments are usefull specially its contribution to the design of more reliable products with greater performance and easier to manufacture. The techniques discussed are of great use in the design and optimization of production processes. They are used in many industries and are essential for engineers because its correct use is a key factor for better quality and productivity leading to more competitive organizations. The students should acquire skills to demonstrate knowledge of the techniques to evaluate and optimize parameters, namely applying such tools in process/product optimization or develop new products and processes. Demonstrate critical and analytical skills in the use of these techniques concerning product performance, lower product costs and shorter development time.

Syllabus
Quality and variability. Savings resulting from reduced variation. Taguchi loss function. Comparison of Philosophies. Introduction to analysis of variance. Analysis of variance with one factor. Fixed effects model ANOVA. Random effects Model ANOVA. Assumptions of the analysis of variance. Application of analysis of variance to the resolution of complex problems. Design of experiments. Experimentation with one factor at time - OFAT versus design of experiments-DOE. Planning. Experimental design in the development of new products and in the improvement of production processes. Factorial and fractional factorial designs in quality improvement. The 2k factorial design. Addtion of center points to the 2k design. Fractional replication of the 2k design. Optimization with DOE. Response surface methods (RSM). Contributions of Taguchi to Quality Engineering. Taguchi methodology in project parameters. Robust Design. Off-line quality and on-line quality.

Demonstration of the syllabus coherence with the curricular unit's learning objectives.
The formal introduction of advanced techniques for quality specially the design of experiments (DOE) at the earliest stage of the development cycle where new products are designed, existing product designs improved, and manufacturing processes optimized, is often the key to overall product success. The factorial and fractional factorial designs are very useful in screening variables allowing to identify the most important. The response surface methodology present a set of tools to use in product/process optimization. Studies of process robustness are a useful approach to reduce the variability in process output variables and minimize noise effects. In this sense the various points of the program introduce techniques that allow to provide students with adequate tools to address the evaluation and optimization of processes / products, always with a perspective of maximizing efficiency.

Teaching methodologies (including evaluation)

The methodology is based on expository lectures on the one hand but also encouraging students to study independently by posing problems to stimulate learning based on problem solving. Learning is driven by issues that are being presented to the students and they decide autonomously. Students will be better prepared to solve real problems, to find the necessary information and to retain the knowledge gained in a stimulating way. In order to achieve these goals students can use several different sources of information. Evaluation can be done by continuous evaluation, (1) or by examination (2). (1) - 2 mini tests that globally contribute 20% towards the final grade (FG). A work corresponding to 40% of FG (minimum 8 points) and a comprehensive test corresponding to 40% of FG (minimum 8 points). To get approval it is required a minimum mark of 9.5 out of 20. (2) - Final exam to get approval it is required a minimum mark of 9.5 out of 20.

Demonstration of the coherence between the teaching methodologies and the learning outcomes

After the frequency of the course it is expected that the students know and understand the various tools of experimental design methodology and also know how to use them in real context in the design and development of products and processes as well as in the optimization always with a perspective of maximizing efficiency and cost reduction. The problem-based learning will better prepare the students for solving real problems, facilitate the application of techniques by the students and will provide better retention of the acquired knowledge being a way of stimulating the learning of new subjects.

Mandatory consultation/existence bibliography:

1. D.C Montgomery, “Introduction to Statistical Quality Control”, 6Th Ed., New York, John Wiley & Sons, 2011.
2. R.H. Myers, D.C. Montgomery, "Response Surface Methodology: Process and Product Optimization Using Designed Experiments”, 2nd Ed., New York, John Wiley & Sons, 2002.
3. G. Taguchi, “Introduction to Quality Enginnering – Designing Quality Into Products and Processes”, Asian Productivity
Organization, 1990.
4. P.J. Ross, “Aplicações das Técnicas de Taguchi na Engenharia da Qualidade”, Makron, MacGraw-Hill, São Paulo, 1991 BIPM www.bipm.org