



UNIVERSITY OF PUERTO RICO  
MAYAGÜEZ CAMPUS  
COLLEGE OF ENGINEERING  
INDUSTRIAL ENGINEERING DEPARTMENT



## COURSE SYLLABUS

### General Information

Course Number: ININ 4078  
Course Title: **Statistical Quality Control**  
Credit-Hours: Three

### Course Description

Statistical control of the quality of processes; statistical methods for quality improvement; univariate and multivariate control charts for variables; attribute control charts; process capability studies; gage and measurement studies; setting specification limits; analysis and design of sampling inspection plans; Mil. Std. 105E, rectifying inspection plans.

### Prerequisites

ININ 4020- **Applied Industrial Statistics**

### Textbook and References

- Montgomery, D. C., **Introduction to Statistical Quality Control**, 7<sup>th</sup> Edition, John Wiley and Sons. 2013.
- Grant and Leavenworth, 1996, *Statistical Quality Control*, 7<sup>th</sup> Edition, McGraw Hill.
- Montgomery, D. C., and Runger, G. C, 2011, *Applied Statistics and Probability for Engineers*, 5<sup>th</sup> Edition, John Wiley and Sons.
- Ryan, T. P, 2000, *Statistical Methods for Quality Improvement*, 2<sup>nd</sup> Edition, John Wiley and Sons.
- Summers, Donna C.S, *Quality*, 5<sup>th</sup> Edition, Prentice Hall, 2010
- Harold Aikens, *Quality Inspired Management*, Prentice Hall, 2010

### Purpose

This is a course primarily designed for majors in Industrial Engineering; however, it is appropriate for engineering students with a basic background in probability and statistics and interested in the production of quality goods and services. The purpose of the course is to prepare technically competent engineers in the areas of statistical process control, process capability analysis, statistical tolerance setting, and basic acceptance sampling procedures. This course is a requirement in the B.S. in IE curriculum.

### Course Goals

After completing the course, the student should:

- Understand the strategic importance of quality.
- Developed abilities to identify, formulate, analyze, and solve quality control problems.
- Be able to select and apply appropriate statistical models to process control situations in

**manufacturing and service industry.**

- Understand the statistical basic of control charts, process capability analysis, **measurement system capability** and acceptance sampling.
- Know the different types of sampling procedures, their statistical basis, their properties, and their limitations and pitfalls.
- Enhanced his/her abilities to work on teams and present results in effective oral presentations and written reports.
- Use Minitab, Excel and MathCad to perform statistical analysis and mathematical calculations, and interpret the results.
- Be aware of the ethical and legal consequences of quality control problems on him, the company, and the public welfare.

**Requirements**

All students are expected to come to class and to the labs all the time, on time, and prepared; do all assigned readings and related homework; actively participate in class discussions and lab activities; and satisfy all assessment criteria to receive credit for the course

**Laboratory Work**

Laboratory practices, exercises, and drills have been designed to enhance the student=s learning experience and, consequently, they are considered a major part of the class. All students are expected to participate. All labs require a written report; some of them will be completed during the labs, but most of them will be turned in at the beginning of the next lab session (usually a week later). Most lab reports are done in teams (usually, three students per team), however, your name cannot appear in a report if you were not present during the corresponding lab practice

**Department and Campus Policies**

**Class attendance:** Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students. Frequent absences affect the final grade, and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student (Bulletin of Information Undergraduate Studies).

**Absence from examinations:** Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero or "F" in the examination missed (Bulletin of Information Undergraduate Studies).

**Final examinations:** Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays (see Bulletin of Information Undergraduate Studies).

**Partial withdrawals:** A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar (see Bulletin of Information Undergraduate Studies).

**Complete withdrawals:** A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes (see Bulletin of Information Undergraduate Studies).

**Disabilities:** After been identified with the professor and the institution, the students with disabilities will receive reasonable accommodations in their courses and evaluations. For more information, please contact *Student Services with Disabilities* at the Student Dean's Office at (Q-019), 787-265-3862 ó 787-832-4040 x-3250 ó 3258

**Ethics:** Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

**Sexual Harassment: Certification 130-2014-2015 states:** Sexual harassment in the workplace and in the study environment is an illegal and discriminatory act and is against the best interests of the University of Puerto Rico. All persons who understand they have been subject to acts of sexual harassment at the University of Puerto Rico may file a complaint and request that the institution investigate, where necessary, and assume the corresponding action by the university authorities. If the complainant is a student, he or she must refer his or her complaint to the Office of the Student Ombudsperson or that of the Dean of Students.

**Hostigamiento Sexual: La Certificación 130-2014-2015, indica:** El hostigamiento sexual en el empleo y en el ambiente de estudio es una práctica ilegal y discriminatoria, ajena a los mejores intereses de la Universidad de Puerto Rico. Toda persona que entienda ha sido objeto de actuaciones constitutiva de hostigamiento sexual en la Universidad de Puerto Rico podrá quejarse para que se investigue, de ser necesario, y se tome la correspondiente acción por parte de las autoridades universitarias. Si quien reclama fuera estudiante, deberá referir su queja a la Oficina de la Procuradora Estudiantil o al Decanato de Estudiantes.

**Certification 36 (2018-2019): Discrimination by Sex and Gender on Modality of Sexual Violence:** "The University of Puerto Rico prohibits discrimination based on sex, sexual orientation, and gender identity in any of its forms, including that of sexual harassment. According to the Institutional Policy Against Sexual Harassment at the University of Puerto Rico, Certification Num. 130, 2014-2015 from the Board of Governors, any student subjected to acts constituting sexual harassment, may turn to the Office of the Student Ombudsperson, the Office of the Dean of Students, and/or the Coordinator of the Office of Compliance with Title IX for an orientation and/or formal complaint."

**Certification 06-43 of the Academic Senate states, "The academic guidelines for offering online courses," defines:** Traditional face-to-face courses are those that have less than 25% of the course's regular contact hours via the Internet. Therefore, a three-credit course will be considered "face to face" if, of the 45 hours of regular contact, 11 or less are taught via the Internet. According to certification 16-43 of the Academic Senate, a course may include up to 25% of its total contact hours via the Internet. The objective of this is so that all professors have this alternative in the case of any unscheduled eventuality.

**Law 51:** The Comprehensive Educational Services Act for People with disabilities states that after identifying with the instructor and the institution, the student with disabilities will receive reasonable accommodation in their courses and evaluations. For more information contact the Department of Counseling and Psychological services at the Office of the Dean of Students (Office DE 21) or call 787-265-3864 or 787-832-4040 x 3772, 2040 and 3864.

### General Topics

| Session                        | Topic  | Reference         |
|--------------------------------|--|-------------------|
| <b>Part I: PROCESS CONTROL</b> |  |                   |
| 1                              | Introduction to control charts. Chance and assignable causes of quality variation  | Secs. 5.1 and 5.2 |
| 2-4                            | Statistical basis of control charts. Rational Subgrouping. Detection and interpretation of patterns on control charts –Phase I and Phase II  | Secs. 5.3         |
| 4-6                            | Control charts for variables. X-Bar and R charts (statistical basis, charts based on standard values, development and use of these charts).  | Secs. 6.1 and 6.2 |
| 7-9                            | Control charts for variables. X-Bar and S charts (statistical basis, charts based on standard values, development and use of these charts). Applications   | Secs. 6.3 to 6.6  |
| 10-13                          | Control charts for attributes. The p chart (statistical basis, charts based on standard values, development and use of these charts, variable sample size, OC Curve)   | Secs. 7.1 and 7.2 |
| 14-15                          | The C and U charts. (statistical basis, charts based on standard values, development and use of these charts, variable sample size, OC Curve), Choice Between Attributes and Variables Control Charts, Guidelines for Implementation | Sec. 7.3 to 7.5   |
| 16                             | Exponentially Weighted Moving Average  | Sec. 9.2          |
| 17-19                          | Multivariate Quality Control   | Sec. 11.1 to 11.3 |

**Part II: Process Capability Studies**

|       |  |                  |
|-------|--|------------------|
| 20-22 | Process Capabilities Studies, Process Capability for Attribute Data                      | Secs. 8.1 to 8.6 |
| 23-25 | Gage and Measurement Capabilities  | Sec 8.7          |
| 26    | Setting Specification Limits on Discrete Components, Estimating Natural Tolerance Limits | Sec 8.8 and 8.9  |

**Part III: Acceptance Sampling for Attributes**

|       |   |           |
|-------|---|-----------|
| 27    | Introduction to Acceptance Sampling. Advantages and disadvantages of acceptance sampling. Types of sampling plans.  | Sec. 14.1 |
| 28    | Single sampling plans for attributes. Introduction and definitions. The OC Curve. Design of a single sampling plan. | Sec. 14.2 |
| 29-30 | Military Standard 105E  | Sec. 14.4 |

\*All readings from Montgomery, 2013

Revised by: Mercedes S. Ferrer-Alameda

| ABET Outcomes |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|
| A             | B | C | D | E | F | G | H | I | J | K |
|               | X |   |   |   |   |   |   |   |   | X |

| IE Program Outcomes |   |   |   |   |   |   |   |   |    |    |
|---------------------|---|---|---|---|---|---|---|---|----|----|
| 1                   | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|                     | X |   |   |   |   |   | X |   |    |    |

**ABET Outcomes:**

B: An ability to design and conduct experiments, as well as to analyze and interpret data.

K: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practices.

**IE Program Outcomes:**

2: Design and implement quality control systems.

8: Use modern telecommunication and computer technology.