SYE6308: STATISTICAL LEARNING IN MANUFACTURING QUALITY CONTROL

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Statistical Learning in Manufacturing Quality Control

Subject Code
SYE - Systems Engineering
Course Number
6308

Academic Unit
Systems Engineering (SYE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to equip students with advanced statistical learning tools and methodologies essential for monitoring and improving quality in manufacturing processes within the big data era. Topics covered include manufacturing quality control, foundational quality improvement philosophies, manufacturing process optimization and statistical process control charts. Additionally, students will learn about essential ideas of statistical learning and machine learning for a more advanced measurement system analysis to improve quality engineering practices related to additive manufacturing and semiconductor manufacturing, such as variability quantification of additively manufactured parts, defect detection of photovoltaic silicon wafers, and control of etching process.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the basic concept of manufacturing quality control, including control chart, z-test, t-test, etc.	20	x		
2	Apply the statistical process control method to analyze the condition of a manufacturing process and identify the process anomalies.	20		x	
3	Describe the key ideas of data analysis methods, including Bayes' theorem, principal component analysis, Fisher's ratio.	30	x		
4	Apply and develop statistical learning methods to enable effective operation and quality monitoring of a real manufacturing system or process.	30			x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures and in-class discussions	Lectures and in-class exercises will be used to implement CILOs 1-4	1, 2, 3, 4	3 hr/week
2	Assignments	Homework will be assigned to consolidate the students' understanding of course material to implement CILOs 1-3.	1, 2, 3	

3	Group projects	Collaborative group projects will be designed to implement CILOS 1-4.	1, 2, 3, 4	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Homework assignments	1, 2, 3	20	-	No
2	Group Projects	2, 3, 4	50	-	Yes

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

Homework assignment (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Submitted written work

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Group projects (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Students will be told to submit paper reports for each group project. For the final project, each group will give in-class presentations to show their results.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Final exam (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Examination questions are designed to assess student's level of achievement of the intended learning outcomes, with emphasis placed on conceptual understanding and correct application.

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Homework assignment (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Submitted written work

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate

Failure
(F) Basic

Assessment Task
Group projects (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Students will be told to submit paper reports for each group project. For the final project, each group will give in-class presentations to show their results.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
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Failure
(F) Basic

Assessment Task
Final exam (for students admitted from Semester A 2022/23 to Summer Term 2024)

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Failure
(F) Basic

Part III Other Information

Keyword Syllabus
- Statistical process control
- Manufacturing process monitoring
- Statistical learning

- Industry 4.0
- Artificial intelligence
- Smart manufacturing

Reading List

Compulsory Readings

	Title
1	Lecture notes and slides.
2	Montgomery, D. C. (2020), Introduction to statistical quality control. John Wiley & Sons.
3	To be announced in canvas.

Additional Readings

	Title
1	Hopp, W. and Spearman, M. (2011), Factory Physics, Waveland Press.