City University of Hong Kong
Course Syllabus

offered by School of Data Science
with effect from Semester A 2019/20

Part I Course Overview

Course Title:	**Statistical Design and Analysis of Experiments**
Course Code:	**SDSC4110**
Course Duration:	**One Semester**
Credit Units:	**3**
Level:	**B4**
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**MA2506 Probability and Statistics**
Precursors: *(Course Code and Title)*	**Nil**
Equivalent Courses: *(Course Code and Title)*	**Nil**
Exclusive Courses: *(Course Code and Title)*	**Nil**

Part II Course Details

1. Abstract

(A 150-word description about the course)

The aim of this course is to provide students with an understanding of design of experiments and advanced statistical data analysis methods in quality engineering. The principles and techniques of experimental design for systematic data collection, estimation of statistical models using the collected data, and their practical implementation issues in quality improvement are introduced.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	**Define** the types of experimental design, and statistical analysis methods.	10%	√	√	
2.	**Apply** various types of experimental designs and experimental design principles to efficiently gather data to discover relationships between system parameters or optimize a complex system.	30%	√	√	
3.	**Apply** statistical analysis methods and model selection principles to correctly analyse experiments.	30%	√	√	
4.	**Use** statistical software package in data collection and analysis for quality problem solving.	10%		√	√
5.	**Design** experiments and **interpret** results for specific industrial settings and quality problems.	20%		√	
	** If weighting is assigned to CILOs, they should add up to 100%.*	100%			

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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 self-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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lectures	Learning through teaching is primarily based on lectures. Mini-lectures and small-group exercises will be used to facilitate conceptual understanding and industrial applications of various statistical tools and techniques.	√	√	√	√	√	26 hours/ semester
Laboratory/ Tutorial Exercises	The team-based exercises provide students with the opportunities to familiarize and apply the statistical tools learnt during the lectures through practical problem solving.			√	√	√	13 hours/ semester

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.					Weighting*	Remarks
	1	2	3	4	5		
Continuous Assessment: 50%							
Test	√	√	√			30%	
Assignments (four assignments) & Laboratory Work		√	√	√	√	20%	
Examination: 50% (duration: 2 hours)							
Examination	√	√	√	√	√	50%	
**The weightings should add up to 100%.*						100%	

For a student to pass the course, at least 30% of the maximum mark for the examination should be obtained.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Test	2-hour test to assess students' conceptual understanding of experimental design methods and ability to correctly analyze experiment data.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Assignments & Lab work	Students' ability to analyze data, apply relevant statistical tools, and draw informed conclusions about an experiment are assessed. Explanation and presentation of results are also assessed.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	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, mostly through numerical calculation, of the various statistical design and analysis of experiments methodologies.	High	Significant	Moderate	Basic	Not even reaching marginal levels

The test, assignments and laboratory report will be numerically-marked, while examination will be numerically-marked and grades-awarded accordingly.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

- Concept of process variability and its relevance to modern quality engineering
- Confidence interval and hypothesis testing
- Measurement system analysis: Gage R&R study
- Principles of experimental design
- Least squares regression for orthogonal designs, and relationship to main effects and interactions
- Factorial and fractional factorial experiments
- Analysis of variance (ANOVA) for factorial and fractional factorial designs
- Response surface design

2. Reading List

2.1. Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Mason, R.L., Gunst, R.F., and Hess, J.L. (2003). *Statistical Design and Analysis of Experiments with Applications to Engineering and Science* (2nd Edition). New York: John Wiley & Sons.

2.2. Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	R. H. Myers, D. C. Montgomery and C. M. Anderson-Cook, *Response Surface Methodology: Process and Product Optimization Using Designed Experiments*, 3rd ed., Wiley, 2009. ISBN: 978-0-470-17446-3
2.	D.C. Montgomery, *Design and Analysis of Experiments*, 8th ed., Wiley, 2012
3.	D.C. Montgomery, *Introduction to Statistical Quality Control*, 7th ed., Wiley, 2012
4.	W.W. Hines & D.C. Montgomery, D.M. Goldsman, and C.M. Borror, *Probability and Statistics in Engineering*, 4th ed., Wiley, 2003
5.	A. Mitra, *Fundamentals of Quality Control and Improvement*, 3rd ed., Wiley, 2008