هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification

(Bachelor)

Course Title:	Statistical Analysis for Chemical Data
Course Code:	STA 1411
Program:	Bachelor of Science in Chemical Laboratories
Department:	Chemistry
College:	Science
Institution:	Imam Mohammad Ibn Saud Islamic University
Version:	2024 – V1
Last Revision Date:	None

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:					
4 (2 Lectures, 2 Lab, 2 Tutorial)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered:					
Level 7 / Year 4					
4. Course general Description:					
The course covers the application of statistical methods to analyze and interpret chemical data. It covers the statistical tests for parametric, non-parametric and binomial data, linear and non-linear regression approaches, Goodness-of-Fit and contingency tables, one-way ANOVA, two-way ANOVA, Experimental Design and methods of Quality Control. Furthermore, students will acquire practical skills in utilizing programming tools by engaging in weekly discussions. Students are required to develop proficiency in coding activities, data manipulation, and effectively communicating their quantitative analyses. This course is essential for students pursuing careers in research, quality control, or any field that relies on data-driven decision-making in chemistry.					
5. Pre-requirements for this course (if any):					
STA 1111					
6. Co-requisites for this course (if any):					
CHM 1253 Computer Applications in Chemical Laboratories					
7. Course Main Objective(s):					
By the end of completion this course students will be able to deal with the following topics: • Test hypotheses on the different parameters, using the corresponding tests to analyze chemical data. • Compute power and type II error probability and make sample size selection decisions for tests on different parameter involving one and two samples. • Apply statistical methods to chemical problems, such as experimental design, standardization, and quality control. • Structure comparative experiments involving two samples as hypothesis tests. • Use simple linear and multiple regression for building empirical models that can be used to predict and understand complex chemical systems. • Use the chi-square goodness-of-fit test to check distributional assumptions, and contingency table tests. • Understand how the analysis of variance is used to analyze the data from these experiments. • Develop students' ability to effectively communicate statistical findings to both technical and non-technical audiences, emphasizing the importance of data visualization and clear reporting.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90	100%
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	**0**	**0%**
4	Distance learning	**0**	**0%**

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**30**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)**	**0**
Total		**90**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	*Course Learning Outcomes*	*Code of CLOs aligned with program*	*Teaching Strategies*	*Assessment Methods*
1	**Knowledge and understanding**			
1.1	Identify statistical treatment and analysis of data.	**K1, K2**	**Lectures, problem solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
1.2	Describe detection limits; interferences; quality control, assurance, and validation of analytical methods in chemical analytical samples.	**K1, K4**	**Lectures, problem solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
1.3	Classify methods of data processing and statistical analysis for chemical analytical samples.	**K1, K4**	**Lectures, problem solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
1.4	Define the analytical quality of obtained chemical data.	**K2, K4**	**Lectures, problem solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
2	**Skills**			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.1	Choose the appropriate schematic diagram of obtained statistical chemical data to solve, analyze and evaluate the results.	S1, S3	Lectures, problem solving, Classroom discussions	Direct: Regular Exams, Lab Assignments, Practical exam
2.2	Analyze the different types of errors and how to overcome them.	S1, S3	Lecturing, Interactive learning.	Direct: Assignments, Practical exam
2.3	Appraise the accuracy and precision of isolated data.	S1, S4	Lecturing, Interactive learning.	Direct: Assignments, Practical exam
2.4	Judge the chosen method for obtained chemical data.	S3, S4	Lectures, problem solving, Classroom discussions	Direct: Regular Exams, Lab Assignments, Practical exam
3	Values, autonomy, and responsibility			
3.1	Perform effectively in groups leadership when appropriate.	V1, V2	Lectures, problem solving, Classroom discussions	Direct: Regular Exams, Lab Assignments, Practical exam
3.2	Develop ethical and consistent actions for personal and public forums.	V1	Lectures, problem solving, Classroom discussions	Direct: Regular Direct: Exams, Lab Assignments, Practical exam
3.3	Produce linked thinking.	V1, V2	Lectures, problem solving, Classroom discussions	Direct: Regular Exams, Lab Assignments, Practical exam

C. Course Content

No	List of Topics	Contact Hours
1	**Statistics of repeated measurements:** The Meaning of Statistics, The Uses of Statistics, Descriptive and Inferential Statistics, Sources of Data: Surveys and Experiments, Retrospective and Prospective Studies, Demographic Data, Population and Sample, Qualitative and Quantitative Data, Scales of Measurement.	8
2	**Significance tests:** Principles of significance testing: one-sided and two-sided tests; Applications of the t-test for comparing means; F-test for comparing variances; Testing for outliers; One-way analysis of variance (ANOVA); The (chi-squared) test; Testing for the normal	16

No	List of Topics	Contact Hours
	distribution; Conclusions and errors in significance tests. ***Applications using statistical software.***	
3	**The quality of analytical Measurements:** Sampling; Quality control; Control charts; Proficiency testing schemes; Method performance studies; Uncertainty; Acceptance sampling; Method validation. ***Applications using statistical software.***	**16**
4	**Correlation and Regression:** Correlation, Regression, Variation and Prediction Intervals, Multiple Regression, Modeling. ***Applications using statistical software.***	**16**
5	**Experimental design:** introduction and nomenclature Randomisation and blocking in experimental design, One-Way ANOVA, Two-way analysis of variance, Latin squares. ***Applications using statistical software.***	**18**
5	**Goodness-of-Fit and Contingency Tables:** Goodness-of-Fit, Contingency Tables, McNemar's Test for Matched Pairs. ***Applications using statistical software.***	**16**
Total		**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Homeworks, Quizzes, Mini projects**	**During the semester**	**15%**
2.	**First Midterm**	**Week 5-6**	**25%**
3.	**Lab exam**	**Week 10-11**	**20%**
4.	**Final Exam**	**Week 15**	**40%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1. ***Statistics and Chemometrics for Analytical Chemistry***, 6th edition; James N Miller, Jane C Miller, Prentice Hal, 2010. **(Main Reference). ISBN-10 : 0273730428, ISBN-13 : 978-0273730422** 2. ***Analytical Chemistry,*** 7th Edition, Gary D. Christian, Purnendu k. Dasgupta, Kevin A Schug, Willy Press, 2014. **ISBN-10 :** 0470887575, **ISBN-13 :** 978-0470887578
Supportive References	***Analyzing Environmental Data,*** Walter W. Piegorsch, A. John Bailer, John Wiley & Sons, Ltd., 2005.
Electronic Materials	**None**
Other Learning Materials	**None**

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	▪ Each classroom should be equipped with a whiteboard and a projector. ▪ Laboratories should be equipped with computers and an internet connection.
Technology equipment (projector, smart board, software)	▪ The rooms should be equipped with data show and Smart Board. ▪ All computers should be equipped with the following software: ▪ Microsoft Excel ▪ IBM SPSS
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	During the semester and at the end of the course each student will complete two evaluation forms.
Effectiveness of Students assessment	Instructor	At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.
Quality of learning resources	Students	During the semester and at the end of the course each student will complete two evaluation forms.
The extent to which CLOs have been achieved	Instructor	At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.
Other	None	

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL
REFERENCE NO.	4/1446
DATE	06/03/1446 (09/09/2024)