Course Specification
(Bachelor)

Course Title:	**Volumetric and Gravimetric Analysis**
Course Code:	**CHM 1236**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammed Ibn Saud Islamic University**
Version:	2024 V1
Last Revision Date:	13 October 2024

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A. General information about the course:

-1. Course Identification

1. Credit hours: 4 (3Lectures, 0 Tutoril, 3 Lab)					
4 (3 Lectures, 0 Tutoril, 3 Lab)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 4/Year 2					
4. Course general Description:					
This course is an introduction to principles, and practices of classical quantitative analytical methods. The course covers the fundamentals of volumetric analysis such as acid – base, complexometric, redox and precipitation titrations. The basic principles and steps of gravimetric analysis will be covered in details.					
5. Pre-requirements for this course (if any)**:**					
Fundamentals of Analytical Chemistry – CHM 1235					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					

This course is intended:

- **To understand the basic concepts and principles of volumetry and gravimetry.**
- **To gain the required theoretical and practical concepts and skills to conduct titrimetric analysis.**
- **To practice preparing, standardizing solutions for quantitative chemical analysis.**
- **To introduce the basic analytical techniques and practical aspects of volumetric analysis.**
- **To solve problems related to titrimetric analysis and interpret analytical results.**

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**	**45**
2.	**Laboratory/Studio**	**45**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		90

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

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To define the main principles of analytical chemistry.**	**K1**	• Six hours are weekly, containing lectures and laboratory activities • A Private study including home exam.	• Short quizzes • Homework • Assignment • marks
1.2	**To state formulas related to statistics and the effect of different errors on the analytical results**	**K2**	• Lecturing, • Solving problems, • Group discussions,	• Homework • Assignment marks • Written exams • Laboratory report
1.3	**To outline some of the analytical chemistry methods and types of concentration expressions.**	**K1, K3**	• Six hours are weekly for laboratory activities • Think, talk, and review the analytical chemistry methods course	• Quizzes • MCQs, • Laboratory report • Written exams
1.4	**To list the principles of safety, emergency responses, and the routes of exposure to hazards, as well as the minimization, controlling, and**	**K4**	• Group Discussions, • Laboratory classes	• Quizzes a • MCQs, • Laboratory reports and performance •

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	laboratory management.			
2.0	Skills			
2.1	To evaluate the types of statistical errors and predict results obtained from chemical analysis statistically.	S1, S3	• Lecturing, • Oral discussion, • Laboratory experiments	• Short quizzes • Exams, • Homework assignment and • laboratory reports
2.2	To use accurate chemical analysis through accurate preparation of standards and reagents.	S1, S3	• Lecturing • Oral discussion • Laboratory experiments	• Homework assignments, • Examination • Laboratory report
2.3	To demonstrate the experimental set-up, different laboratory instruments, and evaluate statistical data	S4, S3	• Provide students with manuals and instructions. • Group discussions • Virtual labs. • Use network and computer software	• Laboratory performance evaluation • Laboratory reports and sheet • Oral tests Assignments marks • Assignments and homework
2.4	To show oral communication skills by presenting seminars, writing reports, and operating electronic mail and Network skills in communicating results with others.	S2, S3	• Oral participation • Group discussions • Lab experiment and reports • Encourage students to use electronic mail to submit homework and assignments.	• Oral tests • Lab performance reports • Sheets Marks • Assignments • Homework marks
3.0	Values, autonomy, and responsibility			
3.1	To appraise effectively the collaboration and inter-professionalism in class discussions or team works, as well as independently.	V1, V2	• Group discussion, • Assignments • Homework • Lab-reports	• Oral tests, • lab performance, Reports, • Sheets Marks • Assignments • Homework marks

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
			•Virtual labs and demonstrations	
3.2	**To show effective awareness to maintain scientific integrity during different assessments, projects, and mini reports**	**V2**	• Group discussion, • Assignments and homework • Lab-reports • Virtual labs and demonstrations	• Oral tests, lab performance, Lab-reports • Sheets Marks • Assignments • Homework marks

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction to titration:** Volumetric Titrimetry, Standard solutions, Standardization &Titration, Indicators, titration error, Types of titrations, Percent Purity Calculations.	3
2.	**Acid/Base Titrations:** Titration: methods of end point determination, acid – base titrations, titration of strong acid with strong base, regions of equivalence point, before, at and after equivalence point, the titration curves, finding the end point with indicators, choosing an indicator.	9
3	**Complexometric Titrations:** EDTA titrations, metal chelate complexes, acid-base properties of EDTA, EDTA complexes, EDTA titration curves, regions of equivalence point, before, at and after equivalence point, titration calculations, metal ion indicators, EDTA titrations techniques, direct, indirect, displacement and back titrations, water hardness, masking.	9
4	**Oxidation/Reduction Titrations:** Basic concepts of Redox reactions, Redox titrations. The shape of redox titration curves, regions of equivalence point, before, at and after equivalence point, finding the end, Redox indicators.	9
5	**Precipitation Titrations:** Precipitation titration curve, Methods of Precipitation Titrations: Mohr's method, Volhard's Method, Fajan's method. Calculations.	9
6	**Gravimetric Analysis**: A successful Gravimetric Analysis: Preparation of the solution, The Precipitation, Digest the Precipitate, Washing and Filtering, Drying or Igniting, Gravimetric Calculations.	6
	Total	45

No	List of Experiments	Contact hours
1	Determination of the citric acidic content in lemon juice (Direct titration).	**3**

2	Determination of purity of vinegar	3
3	Standardization of EDTA using standard ZnO (Direct titration-EBT indicator)	3
4	Determination of of Ca^{2+} using standard EDTA (Direct titration-Murexide indicator)	3
5	Analysis of mixture (Ca+Mg)	3
6	Complexometric Titrations: Determination of calcium by EDTA using EBT (back titration).	3
7	Precipitation Titration: Standardization of Silver Nitrate Solution, and determination of Chloride by the Mohr Method.	6
8	Determination of chloride by Volhard method	3
9	Redox titration: standardization of $KMnO_4$ using standard sodium thiosulfate	3
10	Preparation of triodide solution (I^{3-}). Iodimetric titration of Vitamin C tablets.	3
11	Iodometric titration: Determination of Copper (II) using sodium thiosulfate.	3
12	Gravimetric analysis: Determination of Nickel in Steel.	3
13	Gravimetric analysis: Determination of calcium using Oxalate ion.	3
14	Review.	3
	Total	**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	6th/ 7th week	10 %
2.	Midterm 2	11th/ 12th week	10 %
3.	Quizzes, Home Works, class participation, and mini projects	During the semester	10 %
4.	Laboratory	All the semester	30 %
5.	Final Exam	16-17th week	40 %
6.	Total	All weeks	100 %

*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	Gary D. Christian, Purnendu K. (Sandy) Dasgupta, Kevin A. Schug. **Analytical Chemistry**, 7th Edition. ISBN: 978-0-470-88757-8.
Supportive References	• Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch. **Fundamentals of analytical chemistry**, 9th Edition. ISBN-13: 978-0-495-55828-6. • Daniel C. Harris. **Quantitative Chemical Analysis**, 8th edition,2010, W. H. Freeman & Co., New York, ISBN: 9781429218153.
Electronic Materials	• Blackboard http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true • http://www.chem1.com/acad/webtext/virtualtextbook.html • http://www.shodor.org/UNChem/index.html
Other Learning Materials	**Internal server: www. Elesevier.com**

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students. • In each laboratory, a list of safety and precautions are provided. • In each lab has proper ventilation, and well equipped with instruments. • In each lab, containers for solid waste, liquid waste, and crushed glasses. • Each lab has a small pharmacy for first aid in case of an accident • In each lab, the rules, conditions, and safety mechanism as well list of Risk, Safety precautions according to Merck Catalogue are hanging in the labs.
Technology equipment (projector, smart board, software)	The rooms are equipped with data show, Smart Board, WI-FI access.
Other equipment (depending on the nature of the specialty)	• Appropriate Glasswares for carrying the requested experiments (burrete, pipets, conical flasks, beakers, measuring cylinders, crucibles, dishes, funnels, buchner, buchner flasks) • Appropriate fine chemicals and solvents (Calcium Carbonate, Carbonate ore, Silver Nitrate, sodium thiosulfate., oxalate salt, sodium tri-iodate, EDTA,

Items	Resources
	potassium iodide, iodine, EBT, ammonium oxalate) • pH meter, Analytical balance (3 digits), Drying oven, furnace oven. • Filter papers , clamps, stands

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of Students assessment	**Program Leaders**	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Quality of learning resources	**Students**	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
The extent to which CLOs have been achieved		
Lab Performance	**Students**	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**COUNCIL OF DEPARTMENT OF CHEMISTRY**
REFERENCE NO.	**7 (NO. 2/3)**

DATE	29/3/1446 - 2/10/2024