Course Specification
(Bachelor)

Course Title: Environmental Analytical Chemistry
Course Code: CHM 1205
Program: Bachelor of Science in Environmental Science
Department: Biology
College: Science
Institution: Imam Mohammad Ibn Saud Islamic University
Version: 1
Last Revision Date: -

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 4 (Lecture 3 + Lab 3 + Tutorial 0)					
2. Course type					
A.	☐University	☒ College	☐ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 3/ 2nd Year)					
4. Course General Description:					
This course introduces the students to the basic principles of environmental chemistry. The course focuses on the chemistry of air, water, and soil with specific emphasis on the effects of human-made chemical products and by-products on the environmental processes. The interconnections between different sectors of the environment (soil, water, atmosphere) and the effect of human activities on the natural chemical processes are emphasized. During this course the chemistry of the air, water and soil is studied with an emphasis on the environmental fate of anthropogenic chemicals released into the environment. The course encompasses the knowledge derived from atmospheric chemistry, hydrosphere chemistry, water chemistry, biosphere chemistry, toxic organic compounds and metals, and soil chemistry. Connections with green chemistry are also highlighted.					
5. Pre-requirements for this course (if any)**:**					
CHM 1101 Basics of Chemistry					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
The main aim of the course is to equip students with knowledge of the chemical properties of elements and compounds, as well as the chemical reactions essential for the cycling and accumulation of chemicals in the environment. The course also aims to address the chemistry of elements and compounds in the atmosphere, water and soil, and lays special emphasis on the processes that define the connections and the dependence between individual segments of environment.					

2. Teaching mode (mark all that apply)

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

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)**	-
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	**Identify the relative importance of various reactions, physical processes and transport mechanisms affecting different chemicals in the environment.**	**K1**	-Weekly- lectures -Demonstrations	-Assignments -Written Exams -Presentations -Data Search -Participations

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.2	**Clarify the relationships between the chemical exposures and challenges related to human activities, and their effects on the various segments of the environment**	**K2**	Weekly- lectures -Demonstrations	-Assignments -Written Exams -Presentations -Data Search -Participations
1.3	**Outline the chemistry of elements and compounds in the atmosphere, water, and soil, and describe the principles of solid-, liquid-, and gaseous-state environmental chemistry.**	**K3**	Weekly- lectures -Demonstrations	-Assignments -Written Exams -Presentations -Data Search -Participations
1.4	**Explain how to use chemistry knowledge to find the most proper management methods to ensure sustainable Earth resources.**	**K2, K2**	Weekly- lectures -Demonstrations	-Assignments -Written Exams -Presentations -Data Search -Participations

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
2.0	Skills			
2.1	**Apply the concepts and synthesize the hypotheses from multiple disciplines in environmental chemistry**	**S1**	Weekly- lectures -Demonstrations	-Assignments -Written Exams -Presentations -Data Search -Participations
2.2	**Employ the technical skills to quantify the effects of hazardous chemicals in the environment.**	**S2**	-Lab sessions Demonstrations -Group Discussions	-Lab reports -Presentations
2.3	**Design the plans necessary to study the dose-response relationships of the various chemical compounds and assess their impacts on the environment**	**S2**	-Lab sessions -Lab Demonstrations -Group Discussions	-Lab reports -Presentations
2.4	**Interpret and analyze the environmental research data using the appropriate statistical methods.**	**S3**	-Lab sessions -Lab Demonstrations -Group Discussions	-Lab reports -Presentations
3.0	Values, autonomy, and responsibility			
3.1	**Demonstrate the ability to work independently and cooperate in a team**	**V1**	-Lab sessions -Lab Demonstrations -Group Discussions	-Lab reports -Presentations

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
3.2	**Share in the specialized meetings and present the scientific data professionally through oral presentations and written forms.**	**V1**	-Lab sessions -Lab Demonstrations -Group Discussions	-Lab reports -Presentations
3.3	**Adhere to the relevant ethical rules while performing a research work in chemistry**	**V3**	-Lab sessions -Lab Demonstrations -Group Discussions	-Lab reports -Presentations

C. Course Content

No	List of Topics (Lectures)	Contact Hours
1.	**General introduction to environmental chemistry:** Water pollution: Nature and types of water pollutants - elemental pollutants - heavy metals - metalloids - organic and inorganic species - acidity, alkalinity and salinity - oxygen, oxidants and reductants - pesticides, polychlorinated biphenyls and radionuclides in the aquatic environment.	**9**
2.	**Review the basic calculations of analytical chemistry (chemical concentrations and stoichiometry relationship):** General steps in chemical analysis, Measurements, Fundamental SI units, Derived SI units, other units, Conversion to SI units, Prefixes, Chemical concentrations, Molarity, Molality, Percentage composition, ppm and ppb, Preparing Solutions, Dilution, Stoichiometry Calculations.	**9**
3.	**Acid/Base Titrations: Titration:** methods of end point determination, acid – base titrations, titration of strong acid with strong base. **Oxidation/Reduction Titrations:** Basic concepts of Redox reactions, Redox titrations. **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.	**12**

	Precipitation Titrations: Precipitation titration curve, Methods of Precipitation Titrations: Mohr's method, Volhard's Method, Fajan's method. Calculations.	
5.	**Gravimetric Analysis:** A successful Gravimetric Analysis: Preparation of the solution, The Precipitation, Digest the Precipitate, Washing and Filtering, Drying or Igniting, Gravimetric Calculations.	**6**
6.	**Spectrophotometric analysis** Basic concepts of electromagnetic radiations with materials; Bear's low; evaluation methods driven from Bear's low including comparative method, standard calibration curve, standard addition method. Uv-vis-spectrophotometry, components, operation, and applications in qualitative and quantitative analysis. Flame photometry: components, operation, and applications in qualitative and quantitative analysis	**9**
Total		**45**

Exp	List of Topics (Labs)	Contact Hours
1.	Safety and Laboratory equipment and measurements and reports & Introduction to UV-Vis spectrometer and its operation.	6
2.	Preparing Chemical Solutions by Physical Methods (w/v%, g/L, ppm) Making a standard solution using solid reagents.	**6**
3.	Preparation and standardization of solutions by Chemical method [Molarity, Normality and molality].	**6**
4.	Determination of the Hardness of Natural Waters: A: Conventional EDTA Complexometric Titration.	6
5.	Determination of Chloride Content in Seawater and Tap-water by the Mohr Method.	6
6.	Determination of Sulfate ions in water sample	6
7.	Determination of Iron in a water sample via spectrophotometer	2
8.	Determination of Potassium in water via flame photometer	2
9.	Determination of Sodium and potassium in a blood sample via flame photometer.	2
10.	Revision.	3
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Midterm Exam 1**	5th week	15%
2.	**Midterm Exam 2**	10th week	15%
3.	**Quizzes, Attendance, Participation, Assignments**	During the semester	10%
	Lab Exam	14th week	20%
4.	**Final Exam**	16th week	40%
	Total		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	**Analytical Chemistry, Gary D. Christian,** Purnendu K. (Sandy) Dasgupta, Kevin A. Schug. 7th Edition. ISBN: 978-0-470-88757-8.
Supportive References	**- Fundamentals of analytical chemistry,** Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, 9th Edition. ISBN-13: 978-0-495-55828-6 **- Environmental Chemistry**, S. A. Manahan, (7th Ed.), Boca Raton: CRC Press LLC, 2000, ISBN: 978-1-4398-3276-9.
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lab, classrooms
Technology equipment (projector, smart board, software)	Projector and smartboard
Other equipment (depending on the nature of the specialty)	Environmental chemistry equipment

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student	Direct
Effectiveness of Students' assessment	Program Leader	indirect
Quality of learning resources	Peer Reviewers	Indirect
The extent to which CLOs have been achieved	Program Leader	Indirect
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	