Course Specification
(Bachelor)

Course Title:	Instrumental Analysis
Course Code:	CHM 1332
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(3 Lectures, 0 Turorial, 3 Lab)					
4(3 Lectures, 0 Turorial, 3 Lab)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 6/Year 3					
4. Course general Description:					
The topics taught in this course include Electromagnetic spectrum and its properties, spectrometers, Ultra violet and visible, infrared and Raman, atomic absorption and atomic emission, molecular emission. To study the basic principle of electrochemical techniques such as potentiometry, cyclic voltammetry, and Polarography.					
5. Pre-requirements for this course (if any)**:**					
Volumetric and Gravimetric Analysis – CHM 1236					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
This course is intended: • **To improve students' knowledge of instrumental analysis by providing them with basic concepts and functionality of different instrumental techniques.** • **To develop their hands-on skills to use the different instruments and obtain results using appropriate techniques.**					

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 list the basic principles of instrumental analytical techniques.**	**K1, K2**	• Six hours are weekly, containing lectures and laboratory activities. • A Private study including home exam.	• Quizzes • Assignments • Discussions. • Participation
1.2	**To recognize the components and the role of instruments in solving problems in the physical, chemical and biological samples.**	**K2, K3**	• six hours weekly containing lectures and Laboratory activities • Group discussion	• Quizzes • Assignments. • Oral Discussion • Laboratory Reports
1.3	**To outline absorbance, transmittance and concentrations.**	**K2**	• lectures and Laboratory activities • Group discussion	▪ Quizzes ▪ Home exam ▪ Oral Discussions. ▪ laboratory reports
1.4	**To define the principles of safety, list emergency responses, and outline the routes of exposures to hazards, the minimization, and controlling and laboratory management.**	**K4**	• Laboratory activities • Group discussion .	▪ Participation, ▪ Quizzes and ▪ MCQs, ▪ laboratory performance

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
2.0	**Skills**			
2.1	**To summarize the main instrumental analysis devices and explain the complexity of each instrument, its strengths, and its limitations.**	**S1**	Introduce some examples of instrumental analysis devices and explain the complexity practically and virtually	• Questions in Lectures. • Short Quizzes and Exams. • Participation • Oral Discussion, • Laboratory Reports • Home Exam.
2.2	**To develop the measuring of different variable using spectroscopic lab instruments and differentiate between various types of instruments in terms of parts and functions.**	**S1**	• Group Discussions • Laboratory Experiments	• Questions in Lectures. • Laboratory Reports • Short Quizzes and Exams. • Oral Discussion
2.3	**To prepare standard solutions using different laboratory equipment with calibrating to present data in graphs**	**S1; S4**	• Lectures • Oral Discussions. • Brainstorming Exercises	• Questions in Lectures. • Short Quizzes • Exams.
2.4	**To demonstrate Oral Communication and writing of mini-Reports regarding the instrumental analysis applications using electronic mail and Networks in communicating with others.**	**S2, S3**	• Encourage the students to use the Chemicals, Glassware and Instruments with caring and safety • Laboratory activities.	• Assignments • Laboratory Report.
3.0	**Values, autonomy, and responsibility**			
3.1	**To appraise teamwork, decision-making in unpredictable work, and management of resources and time.**	**V1, V2**	• Brain Storms Exercises • Group Discussion	• Oral Discussion. • Group Discussion • Assignments • Group work sheets

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction to Spectroscopy:** Introduction to spectroscopy (electromagnetic radiation, dual nature of radiation, types of analysis with electromagnetic radiation, UV-Visible radiation, absorption and transmittance), and Beer's law.	6
2	**Instrumentation of spectrophotometry:** Types of electromagnetic radiation source, types of sample holder, types of wavelength selector (prism and grating), detectors such as phototube and photomultiplier tube, single-beam and double-beam spectrophotometers**).**	6
3	**Molecular Absorption Spectroscopy:** Absorption of inorganic and organic compounds, aplications of UV-Visible spectrophotometry for qualitative and quantitative applications (calibration curve method, standard additions method).	6
4	**Molecular Emission Spectroscopy:** Molecular orbitals, absorption and emission, singlet and triplet states, fluorescence, phosphorescence	3
5	**Atomic Absorption Spectroscopy:** instrumentation.	9
6	**Atomic Emission Spectroscopy:** Emission of radiation, flame photometer, instruments, Inductively Coupled Plasma (ICP).	9
7	**Electrochemical analysis:** Nernst equation, pH meter and ion-selective electrodes, potentiometry, voltammeter.	6
	Total	45

No	List of Experiments	Contact hours
1	**Introduction to UV-Vis spectrometer and its operation. Single and double beam. The Maximum Wavelength of Absorbance (λmax).**	3
2	**Verification of transmittance-absorbance relation (A= - Log T).**	3
3	**Standard Calibration Curve and Beer's - Lambert's law.**	3
4	**Determination of Iron (III) in an unknown sample using the standard addition method.**	3
5	**Comparative Method: Determination of KMnO4, Cu+2 concentration using comparative method.**	3
6	**Plotting the Absorption Spectrum of Iron (II) Complex with 1,10- Phenanthroline.**	3
7	**Determination of Iron in aqueous Samples using 1,10- Phenanthroline.**	3

8	Determination of alkali metal concentrations using flame photometer (1)	3
9	Determination of alkali metal concentrations using flame photometer (2)	3
10	Determination of an Infrared (IR) spectrum of some liquid and solid organic compounds.	3
11	Titration of an acid and a base using pH meter.	3
12	Determination of elemental content of a sample by Inductively Coupled Plasma (ICP).	6
13	*Determination of Mn is a manganese salt sample*	3
14	Spectrophotometric Titration: Determination of copper using EDTA	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 (conical flasks, beakers, measuring cyliders, dishes, funnels) • Appropriate fine chemicals and solvents (ferric sulphate, ferrous sulphate or chloride, sodium chloride, potassium chloride, HCl, NaOH) • UV-Vis spectrometer, flame photometer , Analytical balance (3 digits), Drying oven, Inductively Coupled Plasma (ICP). • 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.
	Students	**Indirect:** Second examiner checklist-Course report.
Quality of learning resources	**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	**Course Responsible**	**Direct**: Exams - Course e-Portfolio. **Indirect**: Second examiner checklist-Course report.
	Program Leaders	Indirect: Exams.
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**