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

Course Specification
(Bachelor)

Course Title:	**Spectroscopic analysis**
Course Code:	**CHM 1233**
Program:	**Bachelor of Science in Chemical Laboratories**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammed Ibn Saud Islamic University**
Version:	**2024-** 1
Last Revision Date:	15 September 2024

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A. General information about the course:

-1. Course Identification

1. Credit hours: 4 (3, 3, 0)					
4 (3 Lectures, 3 Lab, 0 Tutorials)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 4/ Third year					
4. Course general Description:					
The course discusses the spectrophotometric and spectrofluorimetric techniques as the main spectro-analytical techniques; other spectral techniques as FTIR and NMR can be used for analytical purpose, but photometry is the most abundant and simple type, and has numerous applications in all fields. Basics of spectrophotometry will be studied such as Beer's law, photometer instrumentation, applications of photometry using calibration curve method, standard additions, photometric titration, and other methods like atomic absorption and atomic emission spectroscopy. It includes some experiments on using some apparatus for different applications.					
5. Pre-requirements for this course (if any):					
Classical Analytical Chemistry CHM 1230					
6. Co-requisites for this course (if any):					
None					
7. Course Main Objective(s):					

By the end of completion of this course students will be to:

- ✓ **Understand novel spectroscopic processes**
- ✓ **Set up novel spectroscopic experiments.**
- ✓ **Introduce to the different physicochemical formalisms used to describe the interaction of matter with electromagnetic radiation.**
- ✓ **Devote to the specific application qualitative and quantitative applications of the vibrational spectroscopy.**
- ✓ **Analyze spectroscopic data of Atomic emission spectrometry and Fluorimetry**
- ✓ **Work independently and in a group.**
- ✓ **Use standard laboratory equipment and modern instrumentation.**
- ✓ **Processing the preliminary results in accordance with the chosen evaluation method**

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 recall the basic principles of instrumental analytical techniques.**	**K1, K3, K4**	• Five hours weekly, containing lectures and laboratory activities • A Private study, including a Homework	Direct: • exams, Quizzes • Homework Laboratory Reports • Participation
1.2	**To recognize the components and role of instruments in solving problems in the physical, chemical, and biological samples.**	**K2, K2; K4**	• Lecturing, group discussions, • Homework and assignment	**Direct:** • exams, quizzes • Oral Discussion • Homework

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
				✓**Participation** • Written exams
1.3	**To state the meaning of, and how, to estimate absorbance, transmittance and concentrations.**	**K1**	• Lecturing, • laboratory experiments Rreports.	**Direct:** • Participation, Quizzes and MCQs, • laboratory reports
2.0	**Skills**			
2.1	**To operate main instrumental analysis devices and explain the complexity of each instrument, its strengths, and limitations.**	**S1**	• Lecturing, group discussion • Laboratory experiments performance	**Direct;** Short quizzes Exams, Homework assignment and laboratory reports
2.2	**To measure different variables using spectroscopic lab instruments and differentiate between various types of instruments in terms of parts and functions.**	**S1, S2**	Lectures and laboratory sessions	**Direct;** • Quizzes • laboratory reports
2.3	**To prepare standard solutions using different laboratory equipment, calibrate instruments during laboratory classes.**	**S1, S4**	• Lecturing • Oral discussion supported by laboratory experiments	**Direct;** • Homework assignment, • Examination • Laboratory report
2.4	**To demonstrate oral communication skills by presenting seminars, writing reports about real pollution cases in the surrounding community, and using electronic mail and network skills to communicate with others.**	**S2, S3**	• Oral participation • Group discussions and lab experiments and reports • Encourage students to use electronic mail to submit homework and assignments.	**Direct;** • Oral tests and lab performance, reports and sheets Marks •Assignments and homework marks

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
3.0	**Values, autonomy, and responsibility**			
3.1	**Appraise teamwork and create awareness to maintain scientific integrity during assessments, projects, and mini-projects.**	**V2**	• Group discussion, assignments, and homework • Lab-reports • Virtual labs and demonstrations	**Direct;** • Oral tests, lab performance, Reports and sheets of Marks • Assignments and homework marks
3.2	**Show personal values and attributes such as honesty, empathy and respect for others**	**V1, V2**	Teamwork and class discussions	**Direct** • lab reports • Mini projects

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction to spectroscopy (electromagnetic radiation, dual nature of radiation, types of analysis with electromagnetic radiation, UV-Visible radiation, absorption and transmittance)**	**3**
2	**Beer's law, instrumentation of spectrophotometry (types of electromagnetic radiation source, types of sample holder)**	**6**
3	**Instrumentation of spectrophotometry (types of wavelength selector (prism and grating), detectors such as phototube and photomultiplier tube, single-beam and double-beam spectrophotometers)**	**6**
4	**Deviation from Beer's law and applications (calibration curve method, standard additions method)**	**9**
5	**Fluorimetry (luminescence, fluorescence and phosphorescence, difference between absorption-excitation-emission, instrumentation, applications)**	**9**
6	**Atomic absorption spectrometry**	**3**
7	**Atomic emission spectrometry**	**3**
8	**Inductively coupled plasma**	**6**
Exp	**List of Topics**	
1	Safety and Laboratory equipment's and measurements and reports & Introduction to UV-Vis spectrometer and its operation. Single and double beam.	**3**

2	Verification of transmittance-absorbance relation and determination of an unknown concentration using calibration curve method (Beer's law).	3
3	determination of an unknown concentration using standard additions method.	3
4	determination of an unknown concentration using spectrophotometric titration.	3
5&6	Determination of the equilibrium constant complex using Molar ratio method	6
7&8	Determination of the equilibrium constant complex using job's method	6
9&10	Determination of Mn and Cr in binary mixture by spectrophotometer	6
11&12	Determination of the equilibrium constant for ferric thiocyanate complex using spectrophotometer	6
13	Spectrophotometric analysis of aspirin	3
14, 15	Revision and Lab. Reports overview	6
Total		90

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes, Attendance, Participation, Homework	All the semester	10%
2.	Laboratory	All the semester	30%
3.	Midterm Exam 1	Around 6th -7th week	10%
4	Midterm Exam 2	Around 11th -12th week	10%
5	Final Exam	Around 15th – 16th week	40%
6	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	• Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, **Fundamentals of Analytical Chemistry**, Cengage Learning; 9th edition (January 1, 2013), ISBN-10 : 0495558281, ISBN-13 : 978-0495558286 • D. A. Skoog, F. J. Holler, S.R. Crouch, **Principles of Instrumental Analysis**", 6th Ed. (2006), Brooks Cole, ISBN: 0495012017, 978-0495012016
Supportive References	• Gary D. Christian, Purnendu (Sandy) Dasgupta, Kevin Schug**, Analytical Chemistry**, Wiley; 7th edition (September 27, 2013), ASIN : B00I8XF5JC, ISBN-10 : 1119770793, ISBN-13 : 978-1119770794 • Douglas A. Skoog, F. James Holler, Stanley R. Crouch, **Principles of Instrumental Analysis**, Cengage Learning; 7th edition (January 1, 2017), ASIN : 1305577213, ISBN-10: 9781305577213, ISBN-13 : 978-1305577213 • Daniel C. Harris, **Quantitative Chemical Analysis**, 8th Ed., 2010, W. H. Freeman & Co., New York, ISBN: 9781429218153. • James W. Robinson, Eileen M. Skelly Frame, George M. Frame II, **Undergraduate Instrumental Analysis**, 6th Ed., 2004, CRC Press.
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**

Items	Resources
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 cylinders)** • **Appropriate fine chemicals and solvents (distilled Water ammonium nitrate)** • **Analytical balance (3 digits), Set gas laws with the glass jacket Data acquisition set for gas laws with glass jacket, PC, Windows® 95 or higher, calorimeter, thermometer, 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	**Course Responsible**	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Other		

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.	3 (NO. 1/3)
DATE	5/3/1446- 8/09/2024