Course Specification

(Postgraduate Programs)

Course Title:	**Instrumental Analysis & Toxicology**
Course Code:	**CHM 6138**
Program:	**Executive Master of Forensic Science**
Department:	**Biology and Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	**2 October 2024**

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours:				
3 (2 Lectures, 2 Lab, 0 Tutorial)				
2. Course type				
A.	☐University	☐College	☒ Program	☐Track
B.	☒ Required		☐Elective	
3. Level/year at which this course is offered: (1/1)				
4. Course General Description:				
This course covers the core concepts and principles of a variety of instrumental analytical procedures commonly employed in the trace measurement of toxicologically important chemical species in complex biological and environmental materials. The course is designed to lay the groundwork for appropriate laboratory practice in toxicological research by teaching students about sampling, sample preparation, detection, and data analysis, as well as other areas of instrumental chemical analysis.				
5. Pre-requirements for this course (if any)**:**				
None				
6. Pre-requirements for this course (if any)**:**				
None				
7. Course Main Objective(s):				

- **Understand principles of a variety of instrumental analytical procedures commonly employed in the trace measurement of toxicologically important chemical species in complex biological and environmental materials.**
- **Develop teaching students about sampling, sample preparation, detection, data analysis, and other areas of instrumental chemical analysis.**
- **Students will develop an understanding of the function of basic components of chemical instrumentation.**
- **Interpret recorded data with standard statistical methods, including noise analysis.**
- **Learn how optical spectroscopy is used to identify specific structural features of molecules.**
- **Learn fundamental aspects of electrochemical analysis involving voltammetry, amperometry, and polarography.**
- **Familiarize with how mass spectrometry is used to determine molecular weights, empirical formulas, and primary structural features of different molecules.**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**60**	**100%**
2	E-learning	**0**	**0%**

No	Mode of Instruction	Contact Hours	Percentage
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**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)……**	**0**
	Total	**60**

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To recall Analytical Methods and relevant Instrumental methods.**	**K1**	▪ Two hours/week lectures. ▪ Self-study ▪ Home-exam.	▪ Regular Exams ▪ Assignments ▪ Short Quizzes ▪ Oral Discussion ▪ Participation.
1.2	**To recognize the full Atomic Spectroscopy & Molecular Spectroscopy Methods and Techniques.**	**K1; K2**	▪ Two hours/week lectures. ▪ Think and justify Molecular Spectroscopy Methods using available references (SDL) online. Open discussion.	▪ Oral Discussion marks ▪ Literatures Survey ▪ Mini-seminar. ▪ Participation.
1.3	**To outline reasonable,**	**K2; K4**	▪Two hours/week lectures.	▪ Midterm. ▪ Assignments.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	appropriate arguments and interpretations for identifying chemical species in complex biological and environmental materials.		▪Group Discussion using available references (SDL)	▪ Group Discussions. ▪ Lab reports ▪ Literatures Survey ▪ Mini-seminar. ▪ Participation.
1.4	**To state the Classification of Analytical Methods and appropriate Analytical aspects of various toxic and drug compounds.**	**K1; K2; K3**	▪Two hours/week lectures. ▪Group Discussion using available references (SDL)	▪ Assignments ▪ Open Discussions. ▪ Literatures Survey ▪ Lab reports ▪ Mini-seminar. ▪ Participation.
2.0	**Skills**			
2.1	**To compare different analytical methods and types of instrumental methods,**	**S1; S4**	▪Lectures activity. ▪Practice some examples of Analytical Methods. ▪Self-study.	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Open Discussions. ▪ Lab reports ▪ Participation ▪ Mini-seminar.
2.2	**To justify the appropriate analytical techniques for chemical species in complex biological and environmental materials.**	**S1; S2; S4**	▪ Lectures and Oral Discussions. ▪ Brainstorming. ▪ Self-study	▪ Questions in Lectures. ▪ Participation ▪ Oral Discussion ▪ Short Quizzes and Exams.
2.3	**To Summarize the analysis and interpretation results in several areas of toxicology accurately, clearly, and concisely.**	**S2; S3**	▪ Lectures ▪ Group Discussions. ▪ Brainstorming. ▪ Self-study	▪Questions in Lectures. ▪Short Quizzes and Exams. ▪Lab reports ▪Participation
2.4	**To demonstrate Oral**	**S4; V1**	▪Group Discussion	▪ Oral

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	Communication for Instrumental Analytical procedures, applied techniques, and Instruments, accompanying writing of mini-reports, operating electronic mail, and networking in communicating with others.		and Assignments ▪ Introduce several examples of Instrumental Analytical procedures, applied techniques, and Instruments, which will require reading, writing, and oral presentation. Encourage students to use electronic mail to submit Home Exams and Assignments.	Discussion, Quizzes, and Exams. ▪ Giving marks for Oral Discussion in Lectures. ▪ Marks given for Assignments
3.0	**Values, autonomy, and responsibility**			
3.1	**To perform a scientific presentation, research, and work independently and integrate with a collaborated group, Using IT to acquire, analyze, and communicate information.**	**V1**	▪ Brainstorming. ▪ Exercises ▪ Group Discussion. Team work.	▪ Oral Discussion. ▪ Group Discussion ▪ Assignments
3.2	**To appraise effectively the collaboration and inter-professionalism in class discussions or teamwork, as well as independently.**	**V1; V2**	▪ Small Group tasks ▪ Open discussion in the classroom. ▪ Office hour guiding. ▪ Group Presentation of mini-projects	▪ Participation ▪ Homework's ▪ Mini-project(s).

C. Course Content:

No	List of Topics	Contact Hours
1.	***Introduction:*** Classification of Analytical Methods, Types of Instrumental Methods, Instruments for Analysis, Calibration of Instrumental Methods, Selecting of Analytical Method.	6
2.	***Atomic Spectroscopy & Molecular Spectroscopy:*** An Introduction to Spectrometric Methods, An Introduction to Optical Atomic Spectrometry, Atomic Absorption and Atomic Fluorescence Spectrometry, Atomic Emission Spectrometry, Atomic Mass Spectrometry, Atomic X-ray Spectrometry, Molecular Luminescence Spectrometry.	6
3	***Electroanalytical Chemistry:*** An Introduction to Electroanalytical Chemistry, Potentiometry, Coulometry, Voltammetry.	6
4	***Separation Methods:*** An Introduction to Chromatographic Separations, Gas Chromatography, High-Performance Liquid Chromatography, Supercritical Fluid Chromatography and Extraction, Capillary Electrophoresis, Electrochromatography, and Field-Flow Fractionation.	12
Total		**30**

No	List of Topics (Laboratories)	Contact Hours
1	**Laboratory rules and safety precautions**	2
2	**Identification of Fibers using FTIR**	2
3	**Forensic Analysis by Infrared Spectrophotometry for Identification of Unknown Drugs**	2
4	**A quantitative analysis of Salicylates in forensic samples by UV-visible spectrometry**	2
5	**Thin Layer Chromatography (TLC) of Analgesic Drugs (Acetaminophen, Aspirin, Caffeine, and Ibuprofen)**	2
6	**Analysis of Ink by Thin Layer Chromatography Experimental**	2
7	**Chromatography of Magic Markers**	2
8	**Chromatography of Magic Markers**	2
9	**Procedure for HPLC Analysis of Analgesic Drugs (Acetaminophen, Aspirin, Caffeine, and Ibuprofen)**	2
10	**Determination of some drugs in forensic Samples using HPLC Analysis**	2
11	**Determination of some drugs in forensic Samples using HPLC Analysis**	2
12	**Identification of Compounds in Forensics using Gas Chromatography**	2
13	**Identification of Compounds in Forensics using Gas Chromatography**	2
14	**Identification of Compounds in forensic Samples using C/MS.**	2

15	Identification of Compounds in forensic Samples using C/MS.	2
Total		30

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Activities (Oral Discussion, Mini-projects, Mini-seminar, Quizzes, Mid-term, Oral Presentation, Participation, Assignments, Lab. reports)	During the semester	30 %
2.	Midterm Exam	8th week	30 %
3.	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	**Principles of Instrumental Analysis**, Douglas A. Skoog, F. James Holler, and Stanley R. Crouch, 7th Edition, 20 Channel Center Street Boston, MA 02210 USA. 2016. ISBN: 978-1-305-57721-3.
Supportive References	NONE
Electronic Materials	NONE
Other Learning Materials	• Blackboard • Multimedia associated with the text book and the relevant websites

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Each classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.** • **In each laboratory, a list of safety and precautions is provided.** • **In each lab has proper ventilation and is well-equipped with instruments.** • **In each lab, there are containers for solid waste, liquid waste, and crushed glasses.** • **Each lab has a small pharmacy for first aid in**

Items	Resources
	case of an accident • In each lab, the rules, conditions, and safety mechanism, as well as a list of Risks and safety precautions according to Merck Catalogue, are hanging in the labs
Technology equipment (Projector, smart board, software)	**The rooms have a data show, Smart Board, and WI-FI access.**
Other equipment (Depending on the nature of the specialty)	• **Appropriate Glassware 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. **Direct:** Course e-Portfolio.
	Course Responsible	**Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** Eternal 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 - **FEGC**)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus

Assessment Areas/Issues	Assessor	Assessment Methods
	Students	review- Accreditation review. **Indirect:** Second examiner checklist-Course report.
The extent to which CLOs have been achieved	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**Department of Chemistry Council**
REFERENCE NO.	**7 (NO. 2/3)**
DATE	**29/3/1446 - 2/10/2024**