Jordan University of Science and Technology

Faculty of Science & Arts

Chemistry Department

CHEM336 Principles Of Chemical Instrumentation

Second Semester 2023-2024

Course Catalog

3 Credit Hours. JORDAN UNIVERSITY OF SCIENCE & TECHNOLOGY DEPARTMENT OF CHEMISTRY COURSE SYLLABUS Fall 2023/2024 Course Information Course Number: CHEM 336 Course Name: Instrumental Analysis Credit Hours: 3 Contact Hours: 3 E-learning Web Address: www.just.edu.jo/e-learning Prerequisites: CHEM 233 Required or Elective or Selected Elective: Required Instructor Information Coordinator: Instructor: Dr. Yahya R. Tahboub Office Hours: Sun, Tue, Th: 1015 - 1115 Office Location: Medicinal Buildings (D3L0) Instructors E-mail: tahboub@just.edu.jo Course Catalog Course Description: (Give a Brief Description of the course as it appears in the study plan) This course covers the principles, design, operational aspects and applications of popular instrumental methods employed in trace chemical analysis. These methods are used in sample preparation, separation, and measurement of analytes and validation of analytical results. Samples vary between prepared standards and real samples. Using a combination of problem-based learning approaches, case studies and traditional lectures, the student will develop critical skills in the area of selecting proper instrumental method for trace analysis of analytes in complex matrices (environmental, biological, industrial). Textbook: (Title, author, and year) Principles of Instrumental Analysis (6th Edition); Authors: D. A. Skoog, F. J. Holler and S. R. Crouch; 2006 References and Supplement Materials: Quantitative Chemical Analysis (9th Edition); Author: D. C. Harris: 2015 Evaluation First Exam 30 % Second Exam 30 % Final (Comprehensive) 40 % Outcomes: By the end of the course, students should be able to: 1. Understand principles, instrumentation and applications of modern instrumentation employed in chemical analysis especially for electrochemical and spectroscopic measurements. 2. Understand the basics of experimental design and use of statistical analysis to validate measurements data. 3. Understand how to design experiments employing these instrumentation (derivetization of analytes. 4. Learn how to use databases to search for scientific literature and extract information from scientific papers. 5. Improvement of oral and written communication skills through preparation and presentation of a survey of instrumental methods for specific analyte. Topics Covered Week Chapter Topics 1 Handouts The analytical process, classical versus instrumental methods, sample measurement and analyte measurement, multi analyte determination with and without separation, derivetization of analyte before measurement 2 1 Statistical evaluation of analytical results: accuracy and precision, linearity and calibration curves, sensitivity and selectivity, recovery and matrix effect, limit of detection and limit of quantitation. 3 14 (Harris) Fundamentals of electrochemistry: charge-current and voltage, electrodes and electrochemical cells, potentials and Nernst equation, calculation of equilibrium constants. 4 23 Potentiometry and Probes: principles of potentiometric methods, reference and indicator electrodes, the pH-electrode, ion selective electrodes. 5 25 Voltammetry: principles of voltammetric methods, linear scan voltammetry and cyclic voltammetry, dropping mercuric electrode (DMC) and polarography. 6 Handouts EXAM 1 Applications of electrochemical methods on environmental and clinical analysis. 7 13 Fundamentals of spectroscopic methods: electromagnetic radiation, absorption, emission and scattering, basic instrumentation for different spectroscopic instrumentation. 8 14 Molecular UV-VIS absorption spectroscopy: Beers law, deviations of Beers law and applications (multiwavelength, determination of equilibrium constant, isosbestic points and flow injection analysis). 9 15 Molecular luminescence spectroscopy: fluorescence and phosphorescence, principles, instrumentation and applications, chemiluminescence. 10 9 Atomic absorption spectroscopy (AAS): principles, instrumentation and applications. 11 10 Atomic emission spectroscopy (AES) : Inductively coupled plasma (ICP) principles, instrumentation and applications, ICP-MS. 12-13 16-19 EXAM 2 Summary of other spectroscopic techniques: IR, NMR and Raman spectroscopy. 14 Principles of Chromatographic separations: retention and resolution, GC and HPLC 15 FINAL EXAM Activities/Projects Project 1 Students (group of 4) will select an electrochemical or spectroscopic method for determination of 4 different analytes in portable water (environmental) Project 2 Students (group of 4) will select an analyte in portable water(environmental) and search for 4 different electrochemical and spectroscopic method for determination of the analyte. Relationship of the Course to ME Outcomes ABET a ? k ? Level (L, M, H) Mechanical Eng. Program Outcomes a ? H a. Apply knowledge of mathematics, and science in practice. b ? M b. Design and conduct experiments as well as analyze and interpret data. c ? L c. c. Design a system, components, or process to meet desired needs. d d. Function on multidisciplinary teams. e ? H e. Identify, formulate, and solve scientific problems. f f. Understanding of professional and ethical responsibility of a chemist. g ? M g. Communicate effectively. h ? H h. Broad education to understand the impact of chemical solutions in global and societal context. i i. Recognition of the need for, and possess the ability to engage in, lifelong learning. j ? L j. Possess knowledge of contemporary issues. k ? k. Use the techniques, skills, and modern chemical tools necessary for scientific practice. l l. Adhere to safety rules and regulations. L: Low, M:Medium, H: High

Teaching Method: On Campus

Text Book	
Title	Principles of Instrumental Analysis

Author(s)	Hollar, Skoog & Ceouch
Edition	6th Edition
Short Name	Prin, Anal
Other Information	

Course References

Short name	Book name	Author(s)	Edition	Other Information
Quant. Anal.	Quantitative Chemical Analysis	Daniel Harris	8th Edition	
Handouts	Handouts	Yahya R. Tahboub	1st Edition	

Instructor	
Name	**Prof. Yahya Tahboub**
Office Location	D3 L-0
Office Hours	
Email	tahboub@just.edu.jo

Class Schedule & Room
Section 1: Lecture Time: Sun, Tue, Thu : 10:30 - 11:30 Room: SB19

Prerequisites		
Line Number	**Course Name**	**Prerequisite Type**
912330	CHEM233 Analytical Chemistry	Prerequisite / Pass
912470	CHEM247 Physical Chemistry (1)	Prerequisite / Pass

Tentative List of Topics Covered		
Weeks	**Topic**	**References**
Weeks 1, 2	Validation of Analytical Methods	From **Handouts**
Weeks 3, 4	Fundamentals of Electroanalytical methods	From **Prin, Anal**, From **Quant. Anal.**
Weeks 5, 6	Potentiometric Methods	From **Prin, Anal**, From **Quant. Anal.**
Weeks 5, 6	Amperometric Methods	From **Prin, Anal**, From **Quant. Anal.**

Weeks 7, 8, 9	Fundamentals of Molecular Spectroscopy	From **Prin, Anal**, From **Quant. Anal.**, From **Handouts**
Weeks 10, 11	UV-VIS Spectroscopy	
Weeks 12, 13	Atomic Spectroscopy	
Week 14	Revision	From **Handouts**

Mapping of Course Outcomes to Program Outcomes	**Course Outcome Weight (Out of 100%)**	**Assessment method**
Understand principles, instrumentation and applications of modern instrumentation employed in chemical analysis especially based on electrochemical and spectroscopic measurements	40%	

Relationship to Program Student Outcomes (Out of 100%)										
a	b	c	d	e	f	g	h	i	j	k

Evaluation	
Assessment Tool	**Weight**
First	30%
Second	30%
Final	40%

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