Department of Physics

College of Education

University of Salahaddin

Subject: Instrumental Analysis

Course Book – (MSc)

Lecturer's name:

Assist. Prof. Dr. Saman Q. Mawlud

(PHD Nanoglass Materials Science)

Academic Year: 2023/2024

Course Book

1. Course name	**Instrumental Analysis**
2. Lecturer in charge	**Dr. Saman Qadir Mawlud**
3. Department/ College	**Physics/Education**
4. Contact	**e-mail: saman.mawlud@su.edu.krd** **Tel:009647504789074**
5. Time (in hours) per week	**Theory: 3** **Practical: 0**
6. Office hours	**Thursday from 12:00-1:00 PM or by appointment**
7. Course code	
8. Teacher's academic profile	https://academics.su.edu.krd/saman.mawlud
9. Keywords	**Instrumental Analysis, Spectroscopic Analysis, Characterization Techniques.**

10. Course overview:

The course will be a survey of major important instrumental analytical techniques; their principles, instrumentation, applications, merits and demerits will be discussed. Time constraints may dictate how much of the materials and the number of topics discussed. This course will give an introduction to modern instrumental techniques including TEM, HRTEM, SEM-EDX, XRD, AFM, STM and DSC and DTA. It is targeted towards master's and PhD students in physics, chemistry, materials science, and bioscience. Theory and application to physical and chemical research problems will be discussed, UV-Vis-NIR spectroscopy, infrared spectroscopy, Raman, fluorescence, nuclear magnetic resonance spectroscopy, etc. Emphasis will be placed on training the students to interpret spectra and to design experiments to address questions related to selectivity, reactivity, kinetics, etc. It also provides detailed information about many photo-physical processes and every possible deactivation pathway of the excited systems, including organic, inorganic, and nanoscale materials. There are three critical steps in the development of nano-modified materials, and these are: (a) materials preparation, (b) property characterization, and (c) material performance or device fabrication. Characterization involves two main processes: structure analysis and property measurements. Structure analysis uses various microscopic and spectroscopic techniques, while property characterization is rather diverse and depends on the individual application.

11. Course objective:

This course intensively covers modern instrumental techniques used to identify and confirm structures of organic and inorganic materials. Problem solving and interpretation of spectra are strongly emphasized in addition to methods used in establishing purity of compounds. Provide students with the theoretical knowledge of the main instrumental analytical techniques applied in materials science; Acquire skills in the use of analytical instrumentation applied in materials science. Spectroscopic

techniques and applied chemistry in the study of surfaces. Acquire skills in choosing the optimal analytical method for a specific material.
Finally, sstudents are expected to learn and understand:

- The basic principles of instruments.
- Characterizations methods.
- Interpretation of results.

12. Student's obligation

A list of additional useful problems will be given to help the student further sharpen your understanding of the subject and your problem-solving skills. The students are required to do these problems, although you may find it useful to do so. Because this subject is one semester, the students are required to do at least one seminars and one scientific report during this semester besides other assignments and students must prepare a full report at the end of the semester. All exams have marks, the full report also has marks, the classroom activities count marks and marks for attendance too.

13. Forms of teaching

Our lecture depends directly on showing the strong point in the lecture via data showing depending on the PowerPoint program and using white board also for presenting more clarification.

14. Assessment scheme

کۆی نمرە Total Score	تاقیکردنەوەی کۆتایی سیمستەر Final Exam	نمرەی کۆششی سیمستەر 50%					پێوەری هەڵسەنگاندن Evaluation Measurement
		تاقیکردنەوەی میدتێرم Midterm Exam	چالاکی Activity	ئەنجامدانی کویز Quiz	نووسینی ڕاپۆرتی زانستی Scientific Reports	پێشکەش کردنی سیمنار بە شیوەی پریسینتەیشن Seminar Presentation	
100%	50%	20%	5%	5%	10%	10%	نمرە Score
		50%					

- Midterm exam 20%
- Seminar Presentation 10%
- Report 10%
- Quiz 5%
- Activity 5%
- Final Exam 50%

Breakdown of overall assessment and examination: 100%

15. Student learning outcome:

After completing this course, students will be able to:
1. Learn about the background of instrumental techniques
2. Understand the instrument techniques and their application in the physics and chemistry research field.
3. Understand the characterization techniques for the nanomaterials.

16. Course Reading List and References:

Books:

1. Zweig, G. and Sherma, J. eds., 1977. Spectroscopic Methods of Analysis (Vol. 9). New York: Academic Press.
2. Khan, M., Do Nascimento, G.M. and El-Azazy, M. eds., 2020. Modern Spectroscopic Techniques and Applications. BoD–Books on Demand.
3. Raja, P. and Barron, A.R., 2019. Physical methods in chemistry and nano science.
4. Shirley Jackson, Characterization of materials, 2022, John Wiley & Sons., ISBN: 9780471266969| DOI: 10.1002/0471266965.

17. The Topics:	Lecturer's name
Introduction Instrumental Analysis	ex: (6 hrs) ex: Weeks One & Two 26/2/2024
The Transmission (High-Resolution Transmission) Electron Microscopy (TEM/HRTEM)	ex: (3 hrs) ex: Week Three
Scanning Electron Microscopy (SEM)	ex: (3 hrs) ex: Week Four
Scanning Probe Microscopy (SPM)	ex: (3 hrs) ex: Week Five
Scanning Tunnelling Microscope (STM)	ex: (3 hrs) ex: Week Six
Atomic Force Microscopy (AFM)	ex: (3 hrs) ex: Week Seven
Energy Dispersive X-ray (EDX/XRF)	ex: (3 hrs) ex: Week Eight
X-Ray Diffraction (XRD)	ex: (3 hrs) ex: Week Nine
Thermal Analysis (TGA/DTA)	ex: (3 hrs) ex: Week Ten
Ultraviolet-Visible-Near infrared Spectroscopy (UV-Vis-NIR)	ex: (3 hrs) ex: Week Eleven
Photoluminescence Spectroscopy (PL)	ex: (3 hrs) ex: Week Twelve

Vibrating Sample Magnetometer (VSM)	ex: (3 hrs) ex: Week Thirteen
18. Practical Topics (If there is any)	
In this section The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture	
19. Examinations: **Q1/ Answer the following:** 1. The images from a Scanning Transmission Electron Microscope (STEM) appear as 3D images. 2. The applied voltage of high voltage transmission electron microscope (HVTEM) is between 100-300 KeV. 3. The most common technique for thinning brittle single crystal materials is ultramicrotomy. **Q2/ Choose the correct answer:** 1. Nanoparticles were discovered in the glass of the Lycurgus cup using: A. an atomic force microscope B. a scanning electron microscope C. a scanning tunneling microscope D. a transmission electron microscope	
20. Extra notes: Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.	
21. Peer review	