**University of Diyala – College of Engineering**

 **Chemical Engineering Department**

 **COURSE SPECIFICATION**

***course Name:*** Instrumental and chemical analysis /

# Code Number: Ch.E213

# Credit Hours: 2

***Pre-requisite(s):*** There is no prerequisite or co-requisite for this course

***Co-requisite(s):*** There is no prerequisite or co-requisite for this course

***Course’s Instructor:***

**lecturer. Mohanad Ali**

Lecturer of Chemical Engineering

Chem. Engr. Dept. / College of Engineering - University of Diyala Tel:

 Email: Mohanad85@uodiyala.edu.iq

# Course Description (or Catalog Data)

1. This module introduces the description we aim to introduce a broad range of modern and classic techniques that are useful in chemistry and chemical Engineering. Topics spectroscopic methods of analysis:
* emission spectroscopy
* absorption spectroscopy (atomic absorption, UV-Visible)
* atomic absorption flame chemistry
* fluorescence, phosphorescence and chemiluminescence spectroscopy
* X-ray spectroscopy methods (absorption, diffraction, fluorescence)
* vibrational spectroscopy (FT-IR, Raman)
1. Other instrumental analysis methods:
* atomic and molecular mass spectrometry
* electrochemical analysis (polarography, pulse polarographic methods, anodic stripping voltammetry)
* thermal methods (thermogravimetric and differential thermal analysis)
1. Separation methods:
* chromatography theory
* liquid chromatography modes and mechanisms: ion-exchange, adsorption, partition and permeation modes as practiced in high-pressure liquid chromatography, open column, thin layer and paper chromatography
* gas chromatography theory, instrumentation and operation
* capillary methods

. The module is taught through 2hrs. per week.

# Textbook and References

1. Funtamental of analytical chemistry**Douglas A. Skoog** *Stanford University* **Donald M. West** *San Jose State University* **F. James Holler** *University of Kentucky***Stanley R. Crouch,** [9tn edition](https://www.google.com/search?sxsrf=ACYBGNS9D1NrdU1KqhVuexS3EqsAwwtYFA:1569327987159&q=Funtamental+of+analytical+chemistry+Douglas+A.+Skoog+Stanford+University+Donald+M.+West+San+Jose+State+University+F.+James+Holler+University+of+Kentucky+Stanley+R.+Crouch+9tn+edition&spell=1&sa=X&ved=0ahUKEwjHqNepuunkAhXPesAKHTScBWIQBQgsKAA)
2. Quantitative Chemical Analysis, seventh edition, Daniel C. Harris
3. INTRODUCTION TO SPECTROSCOPY, 5e, by Donald L. Pavia, Gary M. Lampman, George A. Kriz, and James R. Vyvyan

# Course Goals and Objectives

1. evaluate electromagnetic radiation properties.
2. Express wave properties of light.
3. Explain a particle-like character of light.
4. discuss the interactions electromagnetic radiation and substance.
5. Explain refraction and reflection of light.
6. Summarize polarization and scattering of light.
7. Express absorption and emission of light.
8. classify basic principles for spectroscopic methods.
9. Explain basic equipments of spectroscopy instrument.
10. Recognize the factors that influence the bandwidth in spectral transition.
11. evaluate basic principles of atomic and molecular spectroscopy.
12. Explain atomic absorption and emission spectroscopic methods.
13. Explain basic principles of atomic mass spectroscopy.

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# Course Learning Outcomes

At the end of the class, the student will be able to:

* 1. Explain the theoretical principles of selected instrumental methods within electroanalytical and spectrometric/spectrophotometric methods, and main components in such analytical instruments.
	2. Explain the theoretical principles of various separation techniques in chromatography, and typical applications of chromatographic techniques.
	3. Assess and suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, important sources of interferences and errors, and also suggest alternative analytical methods for quality assurance.
	4. Performing risk assessment of chemical experiments and chemical analytical activity.
	5. Understand how different sampling techniques and instrumental methods can be used in speciation studies.

# Program Student Outcomes

The ***chemical Engineering department*** at Diyala University adapts the **ABET** seven student outcomes as the main student outcomes of the program. These are:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of

engineering solutions in global, economic, environmental, and societal contexts

1. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
2. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
3. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

# Mapping between Module Learning Outcomes and Program Student Outcomes

The following table shows how the ***Module Learning Outcomes*** can achieve and fulfill the ***Program Student Outcomes***:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Module** **Learning** **Outcomes**  |  |  | **Program Student Outcomes**  |  |  |
| 1  | 2  | 3  | 4  | 5  | 6  | 7  |
| a  | **x**  |  |  |  |  |  | **x**  |
| b  | **x**  |  |  |  |  |  | **x**  |
| c  | **x**  |  |  |  |  |  | **x**  |
| d  | **x**  |  |  |  |  |  | **x**  |
| e  | **x**  |  |  |  |  |  | **x**  |
| f  |  |  | **x**  |  | **x**  | **x**  |  |
| g  |  |  |  |  | **x**  |  |  |
| h  | **x**  | **x**  |  |  |  |  |  |
| i  |  |  |  | **x**  |  |  |  |
| j  |  |  | **x**  |  |  |  |  |
| k  |  |  |  |  |  | **x**  |  |

# Assessments

|  |  |  |
| --- | --- | --- |
| Academic System  |  Modular System **√** |  Annual  |
| Course Assessment   | Quest  |  | Final Examination  |
| 40 % ( Mid-Term Test, Quizzes, Homework and assignments, , Oral and ppt. Presentations, and Extracurricular Activities)  | \  | 60%  |

# Grading System

1. Quizzes:
	* There will be (3) open books and notes quizzes during the semester.
	* The quizzes count 5% of the total module grade
	* Attendance count 5% of the total module grade.
2. Mid-Term Test, 1 Nos. and will count 25% of the total module grade.
3. Homework and assignments, and will count 7% of the total module grade.
4. Reports count 8% of the total module grade.
5. Final Exam:
	* The final exam will be comprehensive, Open books and notes, and took place on

 (Saturday-15th - August / 2020) from 1:00 PM - 4:00 PM in rooms (M5 + M6)

* + The final exam will count50% of the total module grade

# Typical Grading

|  |  |
| --- | --- |
| Excellent  | 90-100%  |
| Very Good  | 80-89%  |
| Good  | 70-79%  |
| Fair  | 60-69%  |
| Pass  | 50-59%  |
| Fail  | <50%  |

# Course Academic Calender

|  |  |  |  |
| --- | --- | --- | --- |
| **Week**  | **Covered Material**  | **H.W. and Assignments**  | **Exams**  |
| 1  | 1. Fundamentals of Spectrophotometry
2. Properties of light and it’s interactions with matter
3. Beer’s Laws
4. What Happens When a Molecule Absorbs Light?
 | H.W. 1  |  Quiz 1 |
| 2  |   | Quiz 2  |
| 3  | H.W. 2 | Exam1  |
| 4  | 1. Spectrophotometers Components
2. FT Infrared / U.V visible photometer and Spectrophotometer
3. Applications of Spectrophotometry
 | H.W. 3  |  |
| 5  |   | Quiz 3  |
| 6  | 1. Principle of electrochemical analysis
2. Potentiometric methods
 | H.W. 4  | Quiz 4  |
| 7  |   | Mid-Term Exam |
| 8  | 1. Fundamentals of chromatographic Separations
2. HPLC Separation method
3. Gas chromatography method
 | H.W. 5  |  |
| 9  |  | Quiz 5  |
| 10 |  H.W. 6 |   |
| 11  | 1. Atomic Spectrometry Atomization
2. Flame Temperature and induced plasma Flame Instrumentation
 | H.W. 7  |   |
| 12  |   | Quiz 6 |
| 13  | 1. Principles of Mass Spectrometry
 |   |   |
| 14  | H.W. 8 |   |
| 15  |  | Report Submission  | Quiz 7  |
|  |  |   | Final Exam  |

# Course Policies

1. Ministry, College, and University regulations apply to this module regarding class attendance, punctuality, exams, late submissions, absence with permission, penalties for cheating, and policies for assignments and home works.
2. Home works should be submitted one week after assignment, no late homework is accepted.

# Assessment Plan

1. Reinforcement is done through tests, quizzes, homework and assignments, , oral and ppt. presentations, extracurricular activities and student engagement during lectures as shown in the table below.
2. Listing the responses obtained from student survey conducted at the end of academic semester. A students’ opinion questionnaire is made for a selected group of the students.
3. Students rating performance is made through the results of quizzes and exams related to some of the module outcomes.

# Strategies for Achieving Outcomes and Assessment Methods

|  |  |  |
| --- | --- | --- |
| **Course** **Outcomes**  | **Strategies/Actions**  | **Assessment Methods**  |
| **a)** Knowledge of particle and wave properties of electromagnetic radiation Knowledge of basic principles for selected analytical methods and instruments. | * Lecture plan and in-class activities.
* Each class will commence with a summary of the previous lecture.
* Questions will be asked and the responses will be used to evaluate the students’ understanding of the topics covered.
* Oral and power point presentations by the students are made to participate in the lecture.
 | * In-class questions and discussion.
* Quizzes.
* Homework and assignments.
* Oral and ppt. presentations.
 |
| **b)** Integrate a fundamental understanding of the underlining physics principles as they relate to operational principles of analytical instruments used for atomic, molecular, and mass and optical spectrometry, and chromatography. | * Lecture plan and in-class activities.
* Each class will commence with a summary of the previous lecture.
* Questions will be asked and the responses will be used to evaluate the students’ understanding of the topics covered.
* Oral and power point presentations by the students are made to participate in the lecture.
 | * In-class questions and discussion.
* Quizzes.
* Homework and assignments.
* Oral and ppt. presentations.

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| **c)** be familiar with pragmatic calibration and operation of modern chemical instrumentation. be capable of selecting (and thenimplementing in practice) appropriate techniques for solving specific problemin analytical chemistry, and should have an understanding of pertinent interferences, limitations,  | * Lecture plan and in-class activities.
* Each class will commence with a summary of the previous lecture.
* Questions will be asked and the responses will be used to evaluate the students’ understanding of the topics covered.
* Oral and power point presentations by the students are made to participate in the lecture.
 | * In-class questions and discussion.
* Quizzes.
* Homework and assignments.
* Seminars.
* Oral and ppt. presentations.

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