هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

# Course Specification

| | |
|---|---|
| Course Title: | **Methods of Instrumental Analysis** |
| Course Code: | **415CHEM4** |
| Program: | **Bachelor in Chemistry** |
| Department: | **Chemistry** |
| College: | **College of Science** |
| Institution: | **: Jazan University (JU)** |
| Version: | **T104 2022** |
| Last Revision Date: | **25 December 2022** |

# Table of Contents:

# A. General information about the course:

| Course Identification | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. Credit hours: | | | | | | | | |
| 2. Course type | | | | | | | | |
| a. | University ☐ | College ☐ | Department☒ | Track☐ | Others☐ | | | |
| b. | Required ☐ | Elective☐ | | | | | | |
| 3. Level/year at which this course is offered: | Level **10th**<br>Year **4th** | | | | | | | |

**4. Course general Description**

| *Course Title* | *Course Number* | *Contact Hours (CH)* | | *Credit unit (CU)* | *Year* | *Level* | *Pre-requisite* |
|---|---|---|---|---|---|---|---|
| | | *Lec.* | *Prac.* | | | | |
| *Methods of Instrumental Analysis* | *415CHEM4* | *3* | *2* | *4* | *4* | *10* | *212CHEM3* |

This course aims to give students the basic principles of methods of instrumental analysis and their applications

**Course objectives:** They are to identify the following.

- Recognizing the Electromagnetic Radiation.
- Recognizing the Molecular Ultraviolet and Visible Absorption Spectroscopy.
- Recognizing the Infra-Red Spectroscopy, Spectrum of IR and IR Instrumentation.
- Recognizing the Atomic and emission Spectrometry as well as NMR, MS and X-Ray Spectroscopy

**Syllabus: A-Theoretical contents**
Spectroscopic methods: Introduction to electromagnetic radiation and molecular transitions, UV- and visible radiations and spectrophotometer, Laws of spectral absorption, Fluorimetry, Infra-red spectrometer, atomic absorption and atomic emission spectrometers, NMR spectrometer, Mass spectrometry, X-ray absorption and fluorescence.

**Syllabus: B-Practical contents**

- Selected experiments related to instrumental analysis (See attachment)

**5. Pre-requirements for this course (if any):** ***212 CHEM4***

**6. Co- requirements for this course (if any):** ***None***

**7. Course Main Objective(s)**

This course aims to give students the basic principles of methods of instrumental analysis and their applications

## 1. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1. | Traditional classroom | 33 | 100 |
| 2. | E-learning | | |
| 3. | Hybrid<br>• Traditional classroom<br>• E-learning | | |
| 4. | Distance learning | | |

## 2. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | Lectures | 33 |
| 2. | Laboratory/Studio | 22 |
| 3. | Field | |
| 4. | Tutorial | |
| 5. | Others (specify) | |
| | Total | 55 |

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

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| 1.0 | Knowledge and understanding ; (Upon completion of the course, student will be able to) | | | |
| 1.1 | **Demonstrate a broad understanding and knowledge in different topics of the course as, electromagnetic radiation, molecular transitions after absorption of light, electronic transitions, dual nature of light radiations and use of analytical instruments for qualitative and quantitative chemical analysis and in addition the necessary background in Physics and Mathematics.** | K(1.1) | ***lecture / discussion Seminars /presentation*** | ***Objective questions*** |
| 1.2 | **Describe correctly Chemical phenomena using instrumental** | | ***lecture / discussion /*** | ***Objective questions*** |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | **analysis principles and scientific reasoning** | **K(1.2)** | ***Seminars /Individual presentation*** | |
| 2.0 | Skills ; (Upon completion of the course, student will be able to) | | | |
| 2.1 | **Demonstrate an ability in critical thinking, analytical reasoning and solving problems concerning with instrumental analysis (in measurement and modeling of chemical systems)** | **S(2.1)** | ***lecture / discussion / Seminars /Individual presentation*** | **Solving Problems & chart analysis & Essay questions** |
| 2.2 | **Apply their experimental basics and skills to use laboratory equipment, modern instrumentation, and classical techniques for carrying out experiments in the field of instrumental analysis and to write a report representing the scientific data.** | **S(2.2)** | ***Lab work, group work*** | ***Lab final exam / lab report rubric/ Objective questions*** |
| 2.3 | **Examine his material and lab safety background to Follow proper procedures and regulations for safe handling and use of chemicals.** | **S(2.3)** | ***lab demonstrations / hands-on student learning activities*** | ***Safety exam*** |
| 3.0 | Values, autonomy, and responsibility ; (Upon completion of the course, student will be able to) | | | |
| 3.1 | ***Working as a group leader in cooperation with other colleagues. (P)*** | **V(3.1)** | ***lab demonstrations / whole group and small group discussion*** | ***Practical group work Rubric*** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | **Types of Instrumental Analysis Methods and Applications of Instrumental Methods of analysis and Advantage of instrumental analysis** | 3 |
| 2. | **Electromagnetic field, Elementary theoretical basis of spectroscopy, Electronic Excitations, Electronic absorption** | 3 |

| | | |
|---|---|---|
| 3. | **Spectroscopy, UV-Vis spectroscopy, Absorption laws, Lambert-Beer Law, Instrumentation**<br><br>**Sample Preparation Sample Cleanup** | 6 |
| 4. | **Mass spectroscopy for qualitative and quantitative analysis and nuclear magnetic resonance for identification of the organic compounds (qualitative analysis)** | 3 |
| 5. | **Infrared spectroscopy , IR-Radiation, Modes of Vibration, Typical Infrared Absorption Regions, Frequencies of common structural units, Sample Application, Measurement process , Infrared Absorption, Calibration and Background Spectrum, Advantages of IR analysis, Detection and Quantitation, FT-IR Qualitative and Quantitative** | 3 |
| 6. | **Atomic spectroscopy, Atomic Absorption Spectroscopy (AAS), Atomic Emission Spectroscopy ( AES), Steps of Atomic Absorption measurement, Vaporization and Atomization** | 6 |
| 7. | **Atomic Emission Spectroscopy, Recording and Analysis, Inductively coupled plasma (ICP) and advantages of ICP** | 3 |
| 8. | **X-Ray Analysis, What is X-Ray? , Generation of X-Rays, Sampling, Identifying and Quantization of Compounds** | 3 |
| 9. | **Fluorescence Spectroscopy, What is Fluorescence Spectroscopy? Introduction to Fluorescence Spectroscopy, Sampling** | 3 |
| 10. | **Selected experiments related to instrumental analysis** | **22** |
| Total | | 55 |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | **Homework** | **3-8** | **2 %** |
| 2. | **Quiz** | **4-6** | **3 %** |
| 3. | **Midterm Exam** | **6-8** | **15 %** |
| 4. | **LAB Sheet** | ***10-11*** | **5 %** |
| 5. | **Quiz in Safety** | ***10-11*** | **4%** |
| 6. | **Final practical exam** | ***11*** | **10 %** |
| 7. | **Lab report** | ***2-10*** | **5%** |
| 8. | **Group work evaluation** | ***2-10*** | **6 %** |
| 9. | **Final Exam** | **12-14** | **50 %** |
| | **Total** | | **100 %** |

*As8.sessment 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 | د. إبراهيم الزامل (التحليل الآلي) – دار الخريجي- الطبعة الثالثة 1998 |

| | |
|---|---|
| | - Douglas A. Skoog, F James Holler and Stanley R. Crouch, Principles of instrumental analysis, (2016) 7th edition Thomson Brooks/Cole |
| Supportive References | د. سلامة أحمد خميس محمد ( المطيافيات بين النظرية و التطبيق) جامعة المجمعة- الطبعة الأولى– (143)2010 |
| Electronic Materials | Some course contents and materials are posted on Black board sites |
| Other Learning Materials | Websites on the internet that are relevant to the topics of the course<br>https://learnchemistry12.com/2018/02/modern-chemical-analysis-book.html<br><br>https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumental_Analysis<br><br>https://chem.libretexts.org/Courses |

## 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| facilities<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | ***1 Lecture room(s) for groups of 50 students***<br>1 Lab room for 25 students |
| Technology equipment<br>(projector, smart board, software) | ***Smart board, Data show, Black board, internet*** |
| Other equipment<br>(depending on the nature of the specialty) | **none** |

# F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | ***Student*** | ***Likert-type Survey (CES)***<br>***Indirect*** |
| Effectiveness of students assessment | ***Instructor &***<br>***Course coordinator*** | ***Classroom evaluation (direct & indirect)*** |
| Quality of learning resources | ***Program coordinator*** | ***Indirect*** |
| The extent to which CLOs have been achieved | ***Assessment committee*** | ***Indirect*** |
| Other | | |

**Assessor** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## G. Specification Approval Data

| | |
|---|---|
| COUNCIL /COMMITTEE | Chemistry Department Council **CHEMS2301** |
| REFERENCE NO. | **CHEMS230104** |
| DATE | **11/1/2023G – 18/06/1444H** |

# H. Attachments

## 1- Practical Work

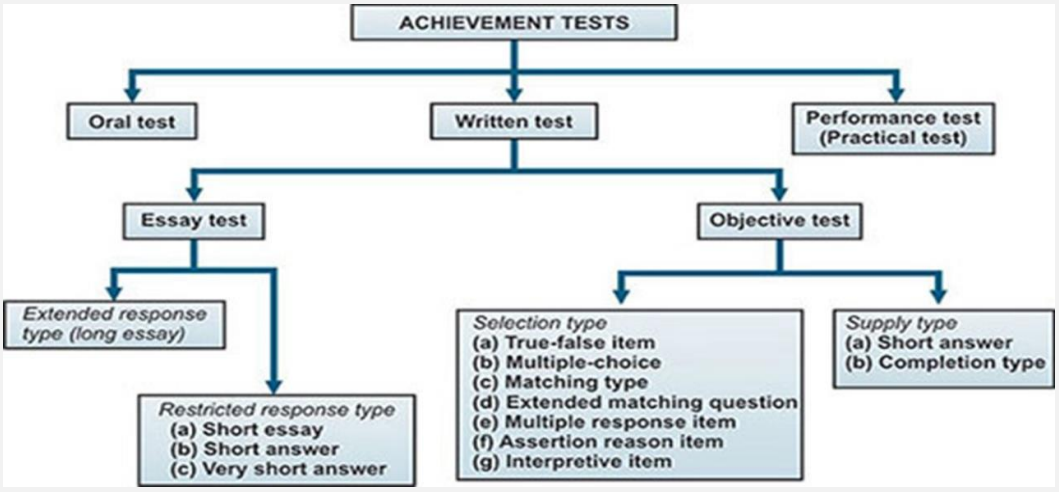
| *No* | *Title of Experiment* | *Tools, Chemicals, and equipment Needed in Experiments* | *Week no.* |
|---|---|---|---|
| ***1.*** | Safety measures | - | 1 |
| ***2.*** | Introduction to spectroscopic analysis and related calculations | - | 2 |
| ***3.*** | Determination of chromium chloride (colored compound) concentration using UV-Vis. Spectrophotometer | Conical flasks, chromium chloride, distilled water<br>UV-Vis. Spectrophotometer | 3 |
| ***4.*** | Determination of potassium nitrate (colorless compound) concentration using UV-Vis. Spectrophotometer | Conical flasks, potassium nitrate, distilled water<br>UV-Vis. Spectrophotometer | 4 |
| ***5.*** | Spectrophotometric determination of paracetamol in tablets | Conical flasks, paracetamol bulk powder, Panadol tablets, distilled water, methanol, UV-Vis. Spectrophotometer | 5 |
| ***6.*** | Spectrophotometric determination of paracetamol in tablets | Conical flasks, paracetamol bulk powder, Panadol tablets, distilled water, methanol, UV-Vis. Spectrophotometer | 6 |
| ***7.*** | Spectrofluorimetric determination of eosin yellow dye | Conical flasks, eosin yellow dye, distilled water Spectrofluorimeter | 7 |
| ***8.*** | IR- identification of benzoic acid | Benzoic acid, potassium bromide, acetone, IR- spectrometer | 8 |
| ***9.*** | Determination of metals concentration using atomic absorption spectrometer | Nickel standard solutions, water samples containing nickel, nitric acid, distilled water, atomic absorption spectrometer | 9 |
| ***10.*** | Determination of metals concentration using flame spectrometer | Nickel standard solutions, water samples containing nickel, nitric acid, distilled water , flame spectrometer | 10 |
| ***11.*** | Final exam | - | 11 |

## 2- Blue Print

| | |
|---|---|
| Course Name | Methods of instrumental analysis |
| Course Code | 415CHEM4 |

| PLOs | K1 | K2 | S1 | S2 | S3 | S4 | V1 | V2 |
|---|---|---|---|---|---|---|---|---|
| CLOs | 1.1 | 1.2 | 2.1 | 2.2 | 2.3 | 2.4 | 3.1 | -- |
| Marks | 10 | 18 | 42 | 20 | 4 | --- | 6 | -- |

| Learning Domain | PLOs | CLOs | Assessment Type | Assessment Tool | No of Questions | Marks of the Assessment | Weight of the Assessment |
|---|---|---|---|---|---|---|---|
| Knowledge & understanding | K1 | 1.1 (10M) | Quiz | Objective questions | 2 | 1 | 1 |
| | | | Mid term | Objective questions | 3 | 2 | 2 |
| | | | Final Exam | Objective questions | 3 | 7 | 7 |
| | K2 | 1.2 (18M) | Quiz | Objective questions | 2 | 1 | 1 |
| | | | Mid term | Objective questions | 4 | 5 | 5 |
| | | | Final Exam | Objective questions | 6 | 12 | 12 |
| Skills | S1 | 2.1 (42M) | H.W | Solving Problems & chart analysis & Essay questions | 4 | 2 | 2 |
| | | | Quiz | Solving Problems & chart analysis & Essay questions | 2 | 1 | 1 |
| | | | Mid term | Solving Problems & chart analysis & Essay questions | 6 | 8 | 8 |
| | | | Final Exam | Solving Problems & chart analysis & Essay questions | 12 | 31 | 31 |
| | S2 | 2.2 (20M) | Practical Sheet | Objective questions | 2 | 8 | 5 |
| | | | Lab Report | Lab report rubric | 5 | 5 | 5 |
| | | | Final Lab Exam | I Task experiment | 1 | 7 | 10 |
| | S3 | 2.3 (4M) | Safety Quiz | Objective questions | 1 | 8 | 4 |
| Value | V1 | 3.1 (6M) | Continuous assessment | Group evaluation rubric | - | 6 | 6 |
| TOTAL | | 100 | | | | | 100 |


ACHIEVEMENT TESTS
Oral test
Written test
Performance test (Practical test)
Essay test
Objective test
Extended response type (long essay)
Restricted response type
(a) Short essay
(b) Short answer
(c) Very short answer
Selection type
(a) True-false item
(b) Multiple-choice
(c) Matching type
(d) Extended matching question
(e) Multiple response item
(f) Assertion reason item
(g) Interpretive item
Supply type
(a) Short answer
(b) Completion type