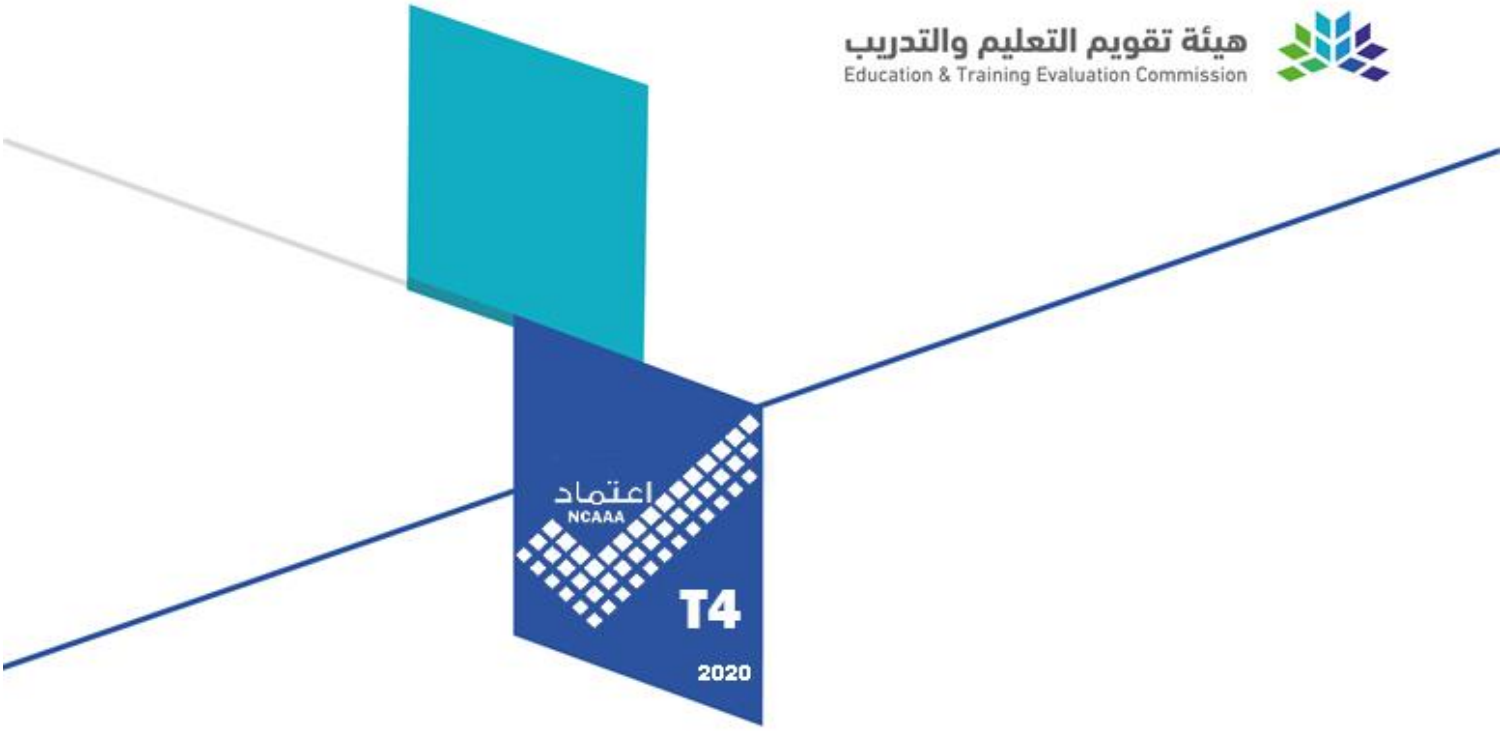
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Methods of instrumental analysis**
Course Code:	**CHEM 415**
Program:	**Bachelor in Chemistry**
Department:	**Chemistry**
College:	**College of Science**
Institution:	**Jazan University (JU)**

Table of Contents

A. Course Identification

1. Credit hours: 4 hours
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: 8th level/4th year
4. Pre-requisites for this course (if any)**:** **CHEM 314**
5. Co-requisites for this course (if any)**:** None

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom** **Lab work**	45CH 30CH	100%
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**45**
2	**Laboratory/Studio**	**30**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**75**

B. Course Objectives and Learning Outcomes

1. Course Description

Course Title	*Course Number*	*Contact Hours (CH)*		*Credit unit (CU)*	*Year*	*Level*	*Pre-requisite*
		Lec.	*Prac.*				
Instrumental Analysis Methods	*CHEM 415*	*3*	*2*	*4*	*4th*	*8th*	*CHEM314*

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)

*See attachment

2. Course Main Objective

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

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	Knowledge and Understanding ***Upon completing this 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. (M)	K.1
1.2	Describe correctly Chemical phenomena using instrumental analysis principles and scientific reasoning (M)	K.2
2	Skills:	S

	CLOs	Aligned PLOs
	upon completion of this course, students are 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) (M)	S.1
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. (M)	S.2
2.3	Examine his material and lab safety background to Follow proper procedures and regulations for safe handling and use of chemicals. (M)	S.3
2.4	Make effective use of communication, and online technology about course topics in order to improve their basic knowledge in writing (report and paper/ poster) with a good verbal and clear scientific language. (M)	S.4
3	Values: Upon completion of this course, students are able to:	
3.1	Work as a group leader in cooperation with other colleagues (M)	V.1

C. Course Content

No	List of Topics	Contact Hours
1	**Types of Instrumental Analysis Methods, Selecting an Analytical Method, Performance Characteristics of Instruments (Figures of Merit), Precision, Bias, Accuracy, Sensitivity Selectivity, Detection limit, Linearity, Linear Dynamic Range, Sampling and sample preparation, Applications of Instrumental Methods of analysis and Advantage of instrumental analysis**	6
2	**Electromagnetic field, Elementary theoretical basis of spectroscopy, Electronic Excitations, Electronic absorption**	3
3	**Spectroscopy, UV-Vis spectroscopy, Absorption laws, Lambert-Beer Law, Instrumentation** **Sample Preparation Sample Cleanup**	12
4	**Mass spectroscopy for qualitative and quantitative analysis and nuclear magnetic resonance for identification of the organic compounds (qualitative analysis)**	6
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**	**30**
Total		75

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding** ***Upon completing this 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.	lecture / discussion /individual presentation	oral and written examinations (Scheduled /presentations
1.2	Describe correctly Chemical phenomena using instrumental analysis principles and scientific reasoning	lecture / discussion /individual presentation	oral and written examinations (Scheduled /presentations
2.0	**Skills** ***Upon completing this 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)	lecture / discussion /individual presentation	Problem-solving exercises / oral and written examinations (Scheduled /presentations
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.	lab demonstrations / whole group and small group discussion /	Practical assignments and laboratory reports
2.3	Examine his material and lab safety background to Follow proper procedures and regulations for safe handling and use of chemicals.	lab demonstrations	Observation of practical skills / Safety exam / Practical assignments and laboratory reports
2.4	Make effective use of communication, and online technology about chemistry topics in order to improve their basic knowledge in writing (report and paper/ poster) with a good verbal and clear scientific language.	research activities	assignments and reports / seminar / report
3.0	**Values** ***Upon completing this course, student will be able to***		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
3.1	Work as a group leader in cooperation with other colleagues	lab demonstrations / whole group and small group discussion	Practical assignments and laboratory reports /
3.2			

2. Assessment Tasks for Students

#	Assessment task*		Week Due	Percentage of Total Assessment Score
1	Homework assignment		2	1
2	Lecture Quizzes		4	3
3	Mid-term exam		6	15
4	Homework assignment		8	1
6	LAB	Final practical exam	15	25
7		Practical sheet	15	5
8	Quiz in safety		15	0
9	Presentation		13	0
10	Final Exam		16	50
11	Total			100

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

Members of staff be available for academic counseling on daily basis for at 4h/day during office hours

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	ـ د. سلامة أحمد خميس محمد (المطيافيات بين النظرية و التطبيق) جامعة المجمعة- الطبعة الأولى– 2010(143) - Douglas A. Skoog, F James Holler and Stanley R. Crouch, Principles of instrumental analysis, (2016) 7th edition Thomson Brooks/Cole.
Essential References Materials	– د. إبراهيم الزامل(التحليل الآلي) – دار الخريجي- الطبعة الثالثة 1998
Electronic Materials	None
Other Learning Materials	Websites on the internet that are relevant to the topics of the course https://learnchemistry12.com/2018/02/modern-chemical-analysis-book.html https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumental_Analysis https://chem.libretexts.org/Courses

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	***1 Lecture room(s) for groups of 50 students*** 1 Lab room for 25 students
Technology Resources (AV, data show, Smart Board, software, etc.)	***Smart board, Data show, Black board, internet***
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**Glass wares, chemicals, Vis./UV-spectrophotometer**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of Teaching and Assessment	***Student***	***Likert-type Survey (CES)*** ***Indirect***
Extent of achievement of course learning outcomes	***Instructor & Course coordinator***	***Class room evaluation (direct & indirect)***
Quality of learning resources	***Program coordinator***	***Indirect***
Exam Quality assessment	***Assessment committee***	***Indirect***

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Chemistry Department Council**
Reference No.	42 / 35 /102 112
Date	17 /09 /1442 Corresponding to 28 / 04 /2021

Attachment: Experimental part
Course Name: Methods of instrumental analysis
Course Code: Chem-415
Year and Level: 4th year / 8th Level

No	*Title of Experiment*	*Tools, Chemicals, and equipment Needed in Experiments*	*No of Weeks*	*Contact Hours*
1	Safety measures		1	2
2	Some calculations and introduction for spectroscopy	None	1	2
3	Determination of chromium chloride (colored compound) concentration using UV-Vis. Spectrophotometer	Conical flasks, chromium chloride, distilled water UV-Vis. Spectrophotometer	1	2
4	Determination of potassium nitrate (colorless compound) concentration using UV-Vis. Spectrophotometer	Conical flasks, potassium nitrate, distilled water UV-Vis. Spectrophotometer	1	2
5	Spectrophotometric determination of paracetamol in tablets	Conical flasks, paracetamol bulk powder, Panadol tablets, distilled water, methanol, UV-Vis. Spectrophotometer	1	2
6	Spectrophotometric determination of paracetamol in tablets	Conical flasks, paracetamol bulk powder, Panadol tablets, distilled water, methanol, UV-Vis. Spectrophotometer	1	2
7	Spectrophotometric determination of metronidazole in tablets	Conical flasks, metronidazole bulk powder, Anazole tablets, distilled water, methanol, UV-Vis. Spectrophotometer	1	2
9	Spectrophotometric determination of metronidazole in tablets	Conical flasks, metronidazole bulk powder, Anazole tablets, distilled water, methanol, UV-Vis. Spectrophotometer	1	2
10	Spectrofluorimetric determination of eosin yellow dye	Conical flasks, eosin yellow dye, distilled water Spectrofluorimeter	1	2
11	Spectrofluorimetric determination of eosin yellow dye	Conical flasks, eosin yellow dye, distilled water Spectrofluorimeter	1	2
12	IR- identification of benzoic acid	Benzoic acid, potassium bromide, acetone, IR-spectrometer	1	2
13	Determination of metals concentration using atomic absorption spectrometer	Nickel standard solutions, water samples containing nickel, nitric acid, distilled water, atomic absorption spectrometer	1	2

14	Determination of metals concentration using flame spectrometer	Nickel standard solutions, water samples containing nickel, nitric acid, distilled water , flame spectrometer	1	2
15	Final exam		1	2