Course Specifications

Course Title:	**Spectrophotometric and Electrochemical techniques**
Course Code:	**4023555-3**
Program:	**Chemistry**
Department:	**Chemistry**
College:	**Faculty of Applied Science**
Institution:	**Umm Al-qura University**

Table of Contents

A. Course Identification

1. Credit hours:	**3 hrs** (2 theoretical + 1 practical)
2. Course type	
a.	University ☐ College ☐ Department ■ Others ☐
b.	Required ■ Elective ☐
3. Level/year at which this course is offered:	**5th level/3rd year**
4. Pre-requisites for this course (if any)**:**	**Volumetric analysis**
5. Co-requisites for this course (if any)**:**	**------**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	2hrs	100%
2	**Blended**		
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	30
2	**Laboratory/Studio**	36
3	**Tutorial**	--
4	**Others** (specify)	--
	Total	66
Other Learning Hours*		
1	**Study**	30
2	**Assignments**	18
3	**Library**	10
4	**Projects/Research Essays/Theses**	
5	**Others** (specify)	
	Total	58

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

The students will be mentioned to prepare an essay or a report from literature using the library, data base services, and/or websites to follow up and update the new topics of the subject of the course

2. Course Main Objective

By the end of this course student have all information about the instrumental analysis and have ability to determine the trace amounts of different compounds and metals.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge:**	
1.1	Describe the principles and applications of spectrophotometric and colormetric analysis	K1 &K2
1.2	Identify electromagnetic spectrum and its interaction with matter	K5
1.3	Define absorption and emission of light by atoms and molecules-types of analysis and devices	K1
1.4	Recognize the spectrophotometric measurements theory and Beer's law deviation	K1
1.5	Familiar with spectrophotometric instrumentation – spectra measurements using UV-vis and IR	K4
1.6	Outline atomic absorption by electrothermal oven- X ray analysis – Applications	K5
1.7	Write an atomic emission spectroscopy and the interference study	K1
1.8	Determine the electrochemical methods in quantitative analysis – Introduction to the principles	K5
1.9	Recognize the potentiometric methods and Potentiometric titrations	K1
1.10	Memorize voltammetry and polarography techniques	K4
1.11	Outline conductmetric methods and their titrations	K5
2	**Skills :**	
2.1	Analyze electromagnetic spectrum and its interaction with matter	S2
2.2	Summarize the principles and applications of spectrophotometric and colormetric analysis	S1 & S2
2.3	Explain the turbidity analysis and flame photometry	S1
2.4	Apply Beer's law applications	S2
2.5	Interpret the inductively coupled plasma (ICP)– principles and applications	S2
2.6	Compare between voltammetry and polarography techniques	S7
2.7	Measure using conductmetric methods and their titrations Evaluate atomic absorption by electrothermal oven- X ray analysis – Applications. Demonstrate potentiometric methods and Potentiometric titrations	S2
3	**Competence:**	
3.1	Ability to work in a team to perform a specific experimental tasks.	C1
3.2	Ability to work independently to handle chemicals	C1
3.3	Ability to communicate results of work to classmate and participation in class or lab oratory discussions.	C3
3.4	Encourage students to use internet for searching certain electronic journals regarding topics of the course.	C3
3.5	Scientific writing and use his/her observations to solve problems.	C2
3.6	Doing research and conduct searches for restoring information.	C3
3.7	Able to calculate and discuss the facts and logical propose methods to solve the difficulties.	C4

C. Course Content

No	List of Topics	Contact Hours

1	General properties of electromagnetic radiation and its interaction with matter, the electromagnetic spectrum as well as the absorption and emission of electromagnetic radiation	4
2	Atomic spectra, molecular spectra, scattered radiation, refracted radiation, dispersed and diffracted radiation, monochromatic vs. polychromatic radiation.	2
3	Instrumentation, radiation sources, monochromators, sample cell (cuvette), detectors, single-beam and double-beam spectrophotometers and photometers.	2
4	Ultraviolet and visible molecular absorption spectroscopy, Beer's law, true and apparent deviations from Beer's law, application of Beer's law to mixtures, calibration curve and the standard addition method.	2
5	Absorbing species, absorption by organic compounds, charge-transfer absorption and ligand-field absorption bands.	2
6	Qualitative and quantitative analysis by UV-Vis. Applications of spectrophotometric methods in chemical equilibrium studies, spectrophotometric titrations	2
7	Turbidimetry and nephelometry	2
8	Molecular fluorescence spectroscopy, theory of molecular fluorescence, relaxation process, resonance lines and stokes shifts, relationship between excitation spectra and fluorescence spectra, effect of structure, temperature and solvents on fluorescence, effect of concentration on fluorescence intensity, instrumentation and applications in organic and inorganic analysis.	2
9	Flame emission and atomic absorption spectroscopy, nebulisation, burners and nebulizers, flames and flame temperature, interferences, flame spectrometric techniques, flame emission spectrometry, flame photometer, flame atomic absorption spectrometry and applications	4
10	Introduction to electroanalytical methods, pH and ion selective potentiometry, glass-membrane electrodes, solid-state sensors, liquid-membrane electrodes, gas-sensing and enzyme electrodes, interferences, potentiometric titrations	2
11	Voltammetry, polarography and amperometric titrations, current-voltage relationships, characteristics of dropping mercury electrode, half-wave potential, modern voltammetric techniques (ASV and CSV), instrumentation, applications, two indicator electrodes amperometric titrations	4
12	Electrogravimetry and calorimetry, basic principles, equipment for electrolytic separation, electrogravimetry, coulometry and coulometric titrations, conductance methods, electrolytic conductivity, measurement of electrolytic conductance, direct concentration determination, conductometric titrations	2
Total		30

Labortory Part:

- Determine copper in copper sulphate solution using spectrophotometric methods
- Determine iron in its salt solution using spectrophotometric methods
- Study reduction oxidation reactions by spectrophotometric methods
- Analysis of $KMnO_4$ and $K_2Cr_2O_7$ in mixture using UV-Vis. spectrophotometer
- Determination of copper using potentiometric titration
- Potentiometric EDTA titrations with the mercury electrode
- Determination of ascorbic acid in fruit juice using Polarographic method
- Determination of amino acids in their solutions
- Determination of hydroxyl group number

D. Teaching and Assessment

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

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	Describe the principles and applications of spectrophotometric and colormetric analysis	Lectures and Library visits	Quiz
1.2	Identify electromagnetic spectrum and its interaction with matter	Lectures and Library visits	Quiz
1.3	Define absorption and emission of light by atoms and molecules-types of analysis and devices	Lectures and Library visits	Exam
1.4	Recognize the spectrophotometric measurements theory and Beer's law deviation	Lectures and Scientific discussion	Exam
1.5	Familiar with spectrophotometric instrumentation – spectra measurements using UV-vis and IR	Scientific discussion	long and short essays
1.6	Outline atomic absorption by electrothermal oven- X ray analysis – Applications	Scientific discussion Web-based study	Exam
1.7	Write an atomic emission spectroscopy and the interference study	Scientific discussion Web-based study	Exam
1.8	Determine the electrochemical methods in quantitative analysis – Introduction to the principles	Scientific discussion Web-based study	Exam
1.9	Recognize the potentiometric methods and Potentiometric titrations	Lectures and Library visits	long and short essays
1.10	Memorize voltammetry and polarography techniques	Lectures and Library visits	Exam
1.11	Outline conductmetric methods and their titrations	Scientific discussion	Exam
2.0	**Skills**		
2.1	Analyze electromagnetic spectrum and its interaction with matter	Lectures	Laboratory demonstration
2.2	Summarize the principles and applications of spectrophotometric and colormetric analysis	Scientific discussion	Essays
2.3	Explain the turbidity analysis and flame photometry	Scientific discussion and Lectures	Exam
2.4	Apply Beer's law applications	Lectures	Laboratory demonstration
2.5	Interpret the inductively coupled plasma (ICP)– principles and applications	Scientific discussion and Lectures	Exam
2.6	Compare between voltammetry and polarography techniques	Web-based study, lecture	Exam
2.7	Measure using conductmetric methods and their titrations Evaluate atomic absorption by electrothermal oven- X ray analysis – Applications Demonstrate potentiometric methods and Potentiometric titrations	Scientific discussion and Lectures	Laboratory demonstration
3.0	**Competence**		
3.1	Ability to work in a team to perform a specific experimental tasks.	Class discussion and research activity	Laboratory demonstration
3.2	Ability to work independently to handle chemicals		Performance on in-practical exams.
3.3	Ability to communicate results of work to classmate and participation in class or lab oratory discussions.	Class discussion and research activity	Overall student performance in Lab.
3.4	Encourage students to use internet for searching certain electronic journals regarding	Lecture, library visit, web-based study	Laboratory demonstration

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	topics of the course.		
3.5	Scientific writing and use his/her observations to solve problems.	Lecture	Cross questions after finishing laboratory work
3.6	Doing research and conduct searches for restoring information.	Lecture, library visit, web-based study	Essay
3.7	Able to calculate and discuss the facts and logical propose methods to solve the difficulties.	Class discussion and research activity	Cross questions after finishing laboratory work

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework or activities.	--	10 %
2	Midterm Exam.	8	20 %
3	Practical Exam.	14	30 %
4	Final Exam. (2hours Exam)	16	40 %
5	**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 :

- **We have faculty members to provide counseling and advice.**
- **Office hours: During the working hours weekly.**
- **Academic Advising for students.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• Gary D. Christian, Purnendu K. Dasgupta and Kevin A. Schug, ***Analytical Chemistry***, 7th edition, WILEY (2014) • Douglas A. Skoog, Donald M. West, James F. Holler and Stanley R. Crouch, ***Analytical Chemistry***, 7th edition, Springer (2014) • Dhruba Charan Dash. *Analytical Chemistry* (2017) PHI Learning Private Limited.
Essential References Materials	Lecture Hand outs available on the coordinator website
Electronic Materials	• **http://www.chemweb.com** • **http://www.sciencedirect.com** • **http://www.rsc.org**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Classrooms capacity (30) students.** • **Providing hall of teaching aids including computers and projector.**
Technology Resources (AV, data show, Smart Board, software, etc.)	▪ **Room equipped with computer and projector and TV.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	• **No other requirements.**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment	Students	Direct
Extent of achievement of course learning outcomes	Peer Reviewer	Direct
Quality of learning resources	Program Leaders	Direct

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	
Reference No.	
Date	2019 - 2020

Received by: Dr. Ismail Althagafi **Department Head**

Signature: **Date: 20/12/2019**