



Course Specifications

Course Title:	Spectroscopy of Organic Compounds
Course Code:	512CHEM-2
Program:	Master of Science in Chemistry
Department:	Chemistry
College:	Science
Institution:	King Khalid University

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A. Course Identification

1. Credit hours: 2
2. Course type a. University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/> b. Required <input checked="" type="checkbox"/> Elective <input type="checkbox"/>
3. Level/year at which this course is offered: Level 2/ Year 1
4. Pre-requisites for this course (if any): No prerequisite
5. Co-requisites for this course (if any): No co-requisite

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	1	50%
2	Blended	0	0%
3	E-learning	1	50%
4	Correspondence	0	0%
5	Other	0	0

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	Lecture	15
2	Laboratory/Studio	0
3	Tutorial	15
4	Others (specify)	0
	Total	30
Other Learning Hours*		
1	Study	30
2	Assignments	30
3	Library	15
4	Projects/Research Essays/Theses	15
5	Others (specify)	10
	Total	100

* 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

This course introduces the essential principles and common applications of spectroscopic tools to identify the molecular structure of organic compounds. It focuses on elucidation the chemical structure of organic compounds using Ultraviolet-Visible spectroscopy, Infrared



spectroscopy, ^1H & ^{13}C -nuclear magnetic resonance, and mass spectrometry. It emphasizes also on the assignment the stereochemistry of organic compounds. In addition, this course will cover also the theory required to understand and successfully implement the 2D-NMR techniques such as COSY, HETCOR, HMQC, HMBC, NOE, and NOESY, and many several solved problems on the interpretation of these spectra will be presented.

2. Course Main Objective: To enable students to

- develop fundamental understanding of spectroscopic techniques - their origin from the interaction of radiation with matter.
- learn the principles and the common application of spectroscopic techniques including UV-Vis, IR, one and two dimensional NMR and MS.
- Analyze and interpret spectroscopic data collected by the methods discussed in it.
- Elucidate the chemical structure of unknown organic compounds.
- Recognize the structure of unknown organic compounds using 2D-NMR (HH-COSY, HMQC, HMBC, TOCSY, 1D-NOE, & NOESY).
- Solve problems related to the structure, purity and concentration of chemicals and to study molecular interactions by choosing suitable spectroscopic methods and interpreting corresponding data.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	Knowledge:	
1.1	To state the fundamental concepts of the effect electromagnetic radiation of atoms and molecules. To Identify the different type of the spectra (UV-IR- ^1H NMR- ^{13}C NMR-MS) and how can interpret it. To know the running of some spectroscopic devices	K1
1.2	To recognize the progress of chemical reaction using IR spectroscopy	K1 & K2
1.3	To describe the chemical structural of unknown compounds using different spectroscopic tools.	K1, K2 & K3
2	Skills :	
2.1	To analyze the products of organic reactions using spectroscopic tools. To distinguish between different classes of organic compounds using IR spectra	S1, S2
2.2	To explain the stereochemistry of cis-trans isomers and E- & Z-configuration using 2D-NOESY spectra	S1,S3
2.3	To interpret the UV-Vis, IR, ^1H -, ^{13}C -NMR, Ms spectra of different compounds	S1, S2, S3
3	Competence:	
3.1	To demonstrate the ability to propose suitable methods for analysis of unknown sample colleagues.	C1
3.2	To participate an oral explanation for a spectra of 1D- and 2-D NMR spectra of known compound.	C2
3.3	To interact positively with colleagues in a group work	C3



C. Course Content

No	List of Topics	Contact Hours
1	Electromagnetic radiation and its interaction with organic molecules	2
2	Introduction (Empirical and molecular formula, Elemental analysis, Index of hydrogen deficiency)	2
3	The Infrared Absorption Spectroscopy	4
4	UV-Vis absorption Spectroscopy	4
5	¹ H- Nuclear Magnetic Spectroscopy	4
6	¹³ C -Nuclear Magnetic Spectroscopy	2
7	2-DNMR techniques- HH-COSY, HMQC, HMBC, TOCSY, 1D-NOE difference, NOESY spectra	4
8	Mass Spectrometry	4
9	Integrated Problems	4
Total		30

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		
1.1	To state the fundamental concepts of the effect electromagnetic radiation of atoms and molecules. To Identify the different type of the spectra (UV-IR- ¹ HNMR- ¹³ CNMR-MS) and how can interpret it. To know the running of some spectroscopic devices	<ul style="list-style-type: none"> Lectures Public discussions and problem-solving Work integrated link between the basic concepts of academic decision with the previous courses studied 	<ul style="list-style-type: none"> Two theoretical exams per semester and represent 20% of the final evaluation Duties and reports through (Blackboard) and represents 5%
1.2	To recognize the progress of chemical reaction using IR spectroscopy	Lectures , Interactive teaching sessions	Written exams, electronic quizzes
1.3	To describe the chemical structural of unknown compounds using different spectroscopic tools.	Tutorials, problem solving sessions	Oral discussion and examinations
2.0	Skills		
2.1	To analyze the products of organic reactions using spectroscopic tools. To distinguish between different classes of organic compounds using IR spectra	<ul style="list-style-type: none"> Lectures websites panel discussions among students Reporting - solution duties 	Written exams, oral exams
2.2	To explain the stereochemistry of cis-trans isomers and E- & Z-configuration using NOESY spectra	<ul style="list-style-type: none"> Tutorials, problem solving sessions Short tests the theory and laboratory 	Oral discussion, written examinations



		<ul style="list-style-type: none"> Assessment of student articles and reports 	
2.3	To interpret the UV-Vis, IR, ¹ H-, ¹³ C-NMR, and Ms spectra of different compounds	<ul style="list-style-type: none"> Tutorials, problem solving sessions Short tests the theory and laboratory Assessment of student articles and reports 	Oral discussion, written examinations
3.0	Competence		
3.1	To demonstrate the ability to propose suitable methods for analysis of unknown sample colleagues.	opened reports on selected topics	Oral discussion
3.2	To participate an oral explanation for a subject in the area.	<ul style="list-style-type: none"> Interactive teaching sessions 	Oral presentation on a group report
3.3	To interact positively with colleagues in a group work	<ul style="list-style-type: none"> Interactive teaching sessions 	<ul style="list-style-type: none"> Short tests Test questions require simple interpretation of statistical information Discussion within a group

2. Assessment Tasks for Students

#	*Assessment task	Week Due	Percentage of Total Assessment Score
1	Homework (Blackboard), reports, presentation & oral discussions	Continuous	10%
2	First Mid-Term exam	6	20%
3	Second Mid-Term exam	12	20%
4	Final exam	15	50%

*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 :

The course instructor is available for at least ten hours every week in the office for any advice and support to the students.

F. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	<ul style="list-style-type: none"> R. M. Silverstein, F. X. Webster, D. J. Kiemle, D. L. Bryce, Spectroscopic Identification of Organic Compounds, Wiley & Sons, New York, 8th Ed., 2015.
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	<ul style="list-style-type: none"> L. D. Field, S. Sternhell, J. R. Kalman, Organic Structures from Spectra, Wiley & Sons, New York, 5th Ed., 2013.
Essential References Materials	<ul style="list-style-type: none"> Spectrochimica Acta part A: Molecular and Biomolecular Spectroscopy Journal of Molecular spectroscopy Progress in nuclear magnetic resonance spectroscopy Journal of Magnetic Resonance Mass spectrometry
Electronic Materials	<ul style="list-style-type: none"> Blackboard: E-Learning Deanship (http://elc.kku.edu.sa/). https://www.wikipedia.org/ https://www.sciencedirect.com/ https://origin-scifinder.cas.org/scifinder/login https://onlinelibrary.wiley.com/ https://www.springer.com/gp
Other Learning Materials	<ul style="list-style-type: none"> Labs contain at least 20 computer. Chem draw or ChemBioOffice programs. Internet access.

2. Facilities Required

Item	Resources
Accommodation Classrooms, laboratories, demonstration) (.rooms/labs, etc)	Lecture room equipped with 20 armchairs
Technology Resources AV, data show, Smart Board, software,) (.etc)	Lecture room equipped with: <ul style="list-style-type: none"> ◆ Smart board ◆ Data show ◆ Computer (MS office, software programs that serve the course as Origin, SPSS, Chem. Draw and other related programs.)
Other Resources Specify, e.g. if specific laboratory) equipment is required, list requirements or (attach a list)	N. A

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
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Effectiveness of Teaching	Instructor or the Department	<ul style="list-style-type: none"> ◆ Confidential completion of standard course evaluation questionnaire ◆ Focused group discussion with small groups of students. ◆ Review with the department chair.
Course delivering	Student	Questionnaire
Course contents (update)	Plan and curriculum committee	Report
Teaching materials	Faculty	Meeting
Learning materials	Student	Discussion

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.	Session number 22
Date	27/04/2021M / 15/09/1442H

