Course Specifications

Course Title:	**Physical Methods in Inorganic Chemistry**
Course Code:	**522CHEM-2**
Program:	**Master of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**King Khalid University**

Table of Contents

A. Course Identification

1. Credit hours:	2
2. Course type	
a.	University ☐ College ☐ Department ■ Others ☐
b.	Required ■ Elective ☐
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**	2	100%
2	**Blended**	0	0%
3	**E-learning**	0	0%
4	**Correspondence**	0	0%
5	**Other**	0	0%

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	30
2	**Laboratory/Studio**	0
3	**Tutorial**	0
4	**Others** (specify)	0
	Total	30
Other Learning Hours*		
1	**Study**	45
2	**Assignments**	10
3	**Library**	15
	Total	70

* 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

The course explains the electronic spectroscopy and development ideas about chemical, electronic structure and molecular bonding. The course explains Vibrational Spectroscopy, Nuclear magnetic resonance, Electron paramagnetic resonance, Mossbauer spectroscopy, mass spectroscopy and X-ray diffraction and Crystallography. The interpretation of spectra and problem solving was maintained

2. Course Main Objective

- Giving advanced ideas on physical and spectroscopic methods in determining the molecular and crystal structures of inorganic compounds.
- It develops more advanced models of chemical bonding and molecular spectroscopy grounded of qualitative and quantitative problems of chemical compounds.
- Providing the students with advanced skills to assign spectral data; UV-VIS, FTIR, NMR, Mass spectra, XRD and etc.
- Understanding the problem solving strategies concerning assignment of chemical structure of chemical compounds and their physicochemical characteristics.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge:**	
1.1	To demonstrate knowledge of the fundamental concepts and principles of electronic spectroscopy in inorganic chemistry	K4 and K5
1.2	To demonstrate understanding of advanced principles of inorganic chemical bonding.	K4 and K5
1.3	To understand the underlying theories of physical methods and measurement.	K4 and K5
2	**Skills :**	
2.1	To analyze, interpret and explain the chemical structures based quantitative and qualitative measurements.	S4
2.2	To apply the problem solving strategies for assigning chemical structure and bonding of inorganic compounds.	S4
3	**Competence:**	
3.1	To present an oral explanation for a subject in the area.	C2, C3 and C4
3.2	To interact positively with colleagues in a group work.	C2, C3 and C4
3.3	To contribute with colleagues to prepare and deliver a presentation and report of group work	C1
3.4	To summarize the literature and sources for an area in the course.	C4

C. Course Content

No	List of Topics	Contact Hours
1	• **Electronic Structure and Spectroscopy of TM Complexes**: MO Theory, Ligand Effects; Metal Effects, Electronic States of TM complexes.	4
2	• **Magnetism**: Phenomenological survey Ideal paramagnets (Curie Law) and weakly interacting paramagnets (Curie-Weiss) Ferromagnets, antiferromagnets, and ferrimagnets, Basics of magnetic measurements. Mechanisms of magnetic coupling Coupling in dimmers Magnetostructural correlations – whether by design or by discovery.	4
3	• **Vibrational Spectroscopy**: Infrared and Raman Spectroscopy, Normal Modes of Vibration, Predicting the Number of Active Bands, Mutual-Exclusion Principle. Internal Coordinates - Stretching and Bending Modes, Combination and Overtone Bands, Solid State Effects, Application to Chemical Problems.	4
4	• **Nuclear magnetic resonance**: Fundamentals, Nuclei for inorganic NMR, NMR Coupling of protons with other nuclei (^{13}C, ^{19}F, ^{31}P, ^{2}H, ^{195}Pt, ...) Other nuclei coupled to proton, Structure Determination, examples and problems.	4

5	• **Electron paramagnetic resonance**: Orbital Angular Momentum and Spin- Orbit Coupling, Introduction to EPR. Zeeman and Hyperfine Interactions, EPR. Application and Interpretation of some practical spectra.	2
6	• **Mossbauer spectroscopy:** Principles of the Method, Nuclear Excitations, The Mössbauer Effect, Overview of Hyperfine Interactions, Recoil-Free Fraction, Isomer Shift, Electric Quadrupole Splitting, Hyperfine Magnetic Field Splitting, More Exotic Measurable Quantities. (Relaxation Phenomena, Phonons, Coherence and Diffraction).	4
7	• **X-ray diffraction and Crystallography**: X-ray Diffraction and Space Groups: Lattices and Space Groups, Reciprocal lattices and Diffraction, A Conceptual walk through 'typical' crystal structure determinations: Data collection, Unit cell and symmetry, Intensities, Data Reduction, Structure Solution, Finishing Touches.	4
8	• **Mass spectra**: Mass Spectrometry of Organometallics isotope patterns doubly charged ions Fragmentation Migration of H, X and Alkyl groups McLafferty rearrangement Influence of operating conditions on MS Metal Carbonyls.	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 demonstrate knowledge of the fundamental concepts and principles of electronic spectroscopy in inorganic chemistry	Lectures , Interactive teaching sessions	Written exams, electronic quizzes
1.2	To demonstrate understanding of advanced principles of inorganic chemical bonding.	Lectures , Interactive teaching sessions	Written exams, electronic quizzes
1.3	To understand the underlying theories of physical methods and measurement.	Tutorials, problem solving sessions	Oral discussion and examinations
2.0	**Skills**		
2.1	To analyze, interpret and explain the chemical structures based quantitative and qualitative measurements.	Lectures, problem solving sessions	Written exams, oral exams
2.2	To apply the problem solving strategies for assigning chemical structure and bonding of inorganic compounds.	Tutorials, problem solving sessions	Oral discussion, written examinations
3.0	**Competence**		

3.1	To present an oral explanation for a subject in the area.	opened essays on selected topics	Presentation
3.2	To interact positively with colleagues in a group work.	Interactive teaching sessions	Oral presentation on a group report
3.3	To contribute with colleagues to prepare and deliver a presentation and report of group work	Interactive teaching sessions	Discussion within a group
3.4	To summarize the literature and sources for an area in the course.	Guided reading of books and articles	Written Reports and summaries

2. Assessment Tasks for Students

#	*Assessment task	Week Due	Percentage of Total Assessment Score
1	Homework	4	5
2	Presentation	5	5
3	quiz & report	9	5
4	Oral discussion	8	5
5	Mid-1	6	15
6	Mid-2	10	15
7	Final exam	16	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 :
5 office hours and through blackboard.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	A. K. Brisdon, Inorganic Spectroscopic Methods, 1st ed., Oxford University Press, 2012.
Essential References Materials	U. Müller, Inorganic Structural Chemistry, 2nd ed., John Wiley & Sons, New York, 2006. A. R. West, Solid State Chemistry and its Applications, 2nd ed., Wiley & Sons, 2014. J. E. Huheey, E. A Keiter, R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed. Prentice Hall, 1997.
Electronic Materials	http://pubs.acs.org/journal/jacsat 0682c-linelibrary.wiley.com/journal/10.1002/(ISSN)1099http://on 3773-http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1521 http://pubs.rsc.org/en/journals/journalissues/dt

Other Learning Materials	Non

2. Facilities Required

Item	Resources
Accommodation Classrooms, laboratories, demonstration) (.rooms/labs, etc	Class and computer
Technology Resources AV, data show, Smart Board, software,) (.etc	Accessible databases and internet
Other Resources Specify, e.g. if specific laboratory) equipment is required, list requirements or (attach a list	No other resources are required

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Course delivering	Student	Questionnaire
Course contents (update)	Plan and curriculum committee	Report
Teaching materials	Faculty	Meeting
Learning materials	Student	Discussion
Assignment	Program instructor and Faculty	Report
Exams	Program instructor and Faculty	Report

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**