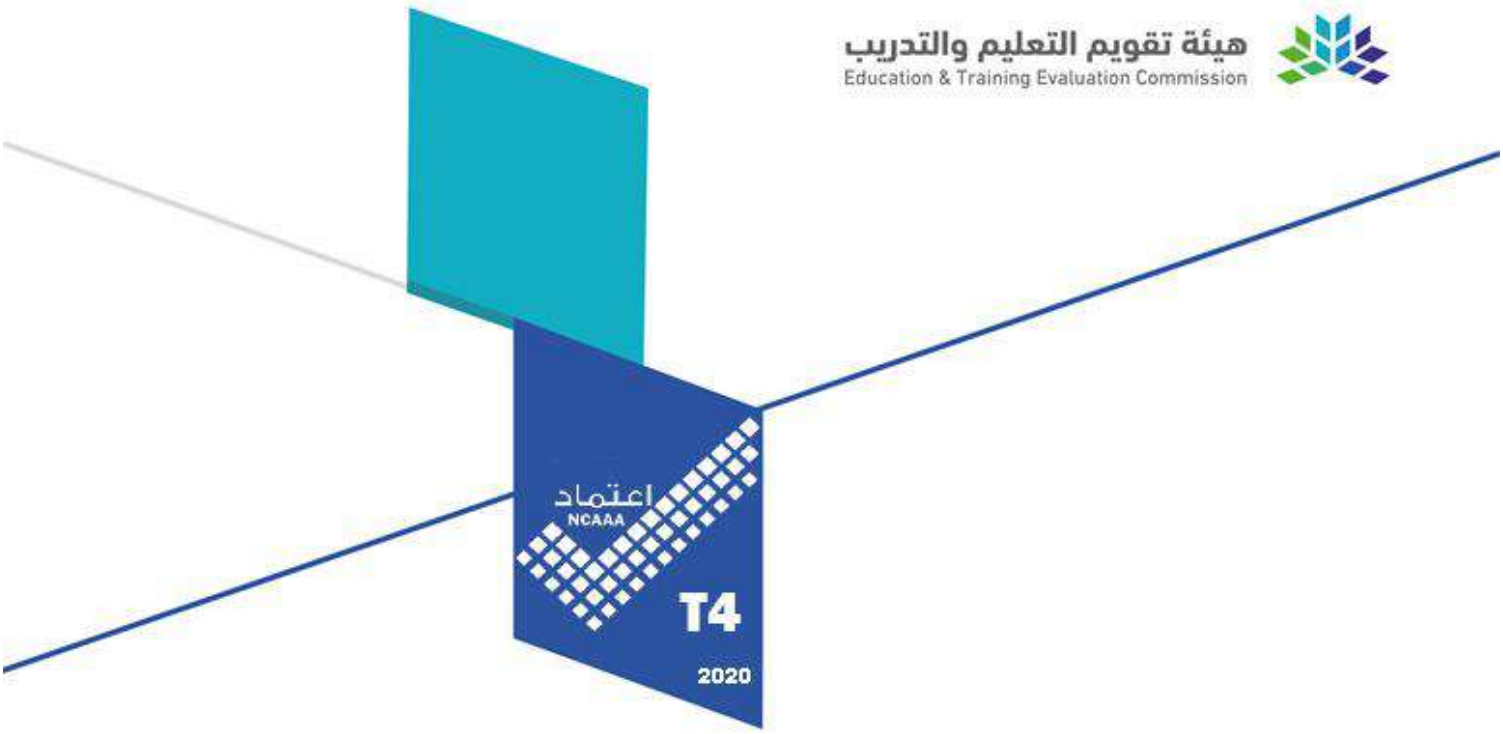
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**General Chemistry 1**
Course Code:	**CHM 101**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

A. Table of Contents

B. Course Identification

1. Credit hours:	**4(2 Lectures, 2 Lab, 2 Tutorial)**
2. Course type	
a.	University ☐ College ☑ Department ☐ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 1/Year 1**
4. Pre-requisites for this course (if any)**:**	**None**
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**	**60**	**100%**
2	**Blended**		
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**40**
2	**Laboratory/Studio**	**20**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**60**

C. Course Objectives and Learning Outcomes

1. Course Description:

This introductory and general chemistry course covers fundamental observations, laws, and theories of chemistry at the basic level. Topics include atoms/molecules, stoichiometry, acids/bases, solutions, equilibrium, gases, solids, liquids, thermodynamics, the periodic table, and chemical bonding. The chemistry lab is taken in parallel with the course and covers the following basic experiments: density, mass-mass relationship, limiting reactant, acid-base titrations, solubility product, reactions in aqueous solution, Calorimetry and redox reactions.

2. Course Main Objective: ***This course is entended:***

- Recognize atoms, molecules and ions, atomic theory, structure of the atom, isotopes, chemical formulas, naming compounds, stoichiometry, Avogadro's number, mass spectrometer, empirical formulas, chemical equations, limiting reagents and changes taking place.
- Describe chemical reactions in aqueous solutions and their general proprieties.
- Recall types of chemical reactions (precipitation, acid-base, oxidation-reduction).
- Solve ideal gas equation, stoichiometric data, partial pressures and the kinetic molecular theory of gases,
- Identify quantum theory, electronic structure, Bohr's theory, dual nature of electron, quantum mechanics, and electron configuration, periodic classification periodic variation in physical properties, ionization energy, and electron affinity.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	To recognize the atomic theory and structure of the atom.	K1, K3
1.2	To describe different phenomena related to chemical reactions and its stoichiometry.	K1
1.3	To memorize gases laws and their physical properties.	K1, K3
2	**Skills :**	
2.1	To differentiate between protons, neutrons and electrons.	S1
2.2	To write correct chemical equations and balance it.	S1
2.3	To interpret the ideal gas laws and illustrate chemical calculations.	S1,S3
2.4	To demonstrate ability to do oral communication and technical writing skills through writing and oral presentation of mini reports, operate electronic mail and Network in communicating with others.	S1, S2, S3
3	**Values:**	
3.1	To appraise coordination in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.	V1;V2

D. Course Content

No	List of Topics	Contact Hours
	Topics to be covered (Lectures and Tutorial)	
1	**The Study of Change:** Science for the twenty-first century, the study of chemistry, the scientific method and hypothesis, a law and theory, matter and substance, mixture, physical means, elements and compounds, classification of matter, The three state of matter, Types of changes, Physical and chemical properties of matter, Extensive and Intensive properties, Measurement, handling numbers, Accuracy and precision	**5**
2	**Atoms, Molecules and Ions:** The atomic theory, Dalton's atomic theory, Cathode ray tube, Millikan's experiment, Types of radioactivity, Thomson's model, Rutherford's experiment, The structure of the atom, Atomic number, Masse number, Isotopes, The periodic table, Molecules and ions, Formulas and models, Chemical formulas, molecular formula, empirical formula, Formula of Ionic compounds, Chemical nomenclature, Naming compounds, Organic chemistry.	**5**
3	**Masse Relationships in chemical reactions (Stoichiometry):** The mole, Avogadro's number, Molar mass, Molecular mass, Formula mass, the mass spectrometer, Percent composition and empirical formula, Experimental determination of empirical formulas, Chemical reaction, Chemical equations, Balancing chemical equations, Amounts of reaction and reactants and products, Reaction Yield, Limiting reagents.	**8**
4	**Reaction in aqueous solutions:** General proprieties of aqueous solutions, Solution, solute, solvent, An electrolyte and nonelectrolyte, Precipitation reactions, Solubility, Properties of acids, Properties of bases, Arrhenius acid and base, Brønsted acid and base, Neutralization reaction. Oxidation-reduction reactions, Oxidation number, Types of oxidation-reduction reactions, Solution Stoichiometry, Concentration, dilution, indicators, Equivalence point, Gravimetric analysis, Acid base titrations, Redox titrations.	**7**
5	**Gases:** Physical characteristics of gases, Units of pressure, Boyle's law, Charles' & Gay-Lussac's Law, Avogadro's law, and The gas laws. The ideal gas equation, Gas stoichiometry, Dalton's law of partial pressures, The kinetic	**5**

	molecular theory of gases, Molecular Speed Distribution, Gas diffusion, Gas effusion, Deviations from ideal behavior.	
6	**Quantum Theory and the Electronic Structure of Atoms:** Properties of waves, Line emission spectrum, Bohr's model of the atom, The dual nature of the electron, Schrodinger Wave Equation, Quantum numbers, Atomic Orbitals, Aufbau principle, Hund's rule, Electron Configuration.	**5**
7	**The Periodic Table:** Development of the periodic table, ground state electron configurations of the elements, classification of the elements, electron configurations of cations and anions, isoelectronic, effective nuclear charge, atomic radii, ionization energy, electron affinity, diagonal relationships on the periodic table, properties of oxides across a period.	**5**
Topics to be covered (Laboratories)		
1	Safety and Laboratory equipment and measurements and How to make a report & Density of liquids & Density of regular and irregular solids	**2**
2	Stoichiometry: Mass-mass relationship	**2**
3	The chemical composition by mass percentage	**2**
4	Preparation of primary standard and dilution rule & titration	**2**
5	Determination of the empirical formula	**2**
6	Strong acid-strong base titration	**2**
7	Vinegar Analysis, Mass % & Reactions in Aqueous Solutions	**2**
8	Precipitation reaction & Limiting reactant	**2**
9	Redox titration of Fe2+	**2**
10	Determination of the specific heat of metal	**2**
Total		**60**

E. 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**		
1.1	To recognize the atomic theory and structure of the atom.	Lecturing	Short quizzes
1.2	To describe different phenomena related to chemical reactions and its stoichiometry.	Solving problems, Homework and assignment	Homework and assignment marks and written exams
1.3	To memorize gases laws and their physical properties.	Discussions, Laboratory classes	Quizzes and MCQs, laboratory report
2.0	**Skills**		
2.1	To differentiate between protons, neutrons and electrons.	Lecturing and oral discussion	Short quizzes and Multiples Choice Questions
2.2	To write correct chemical equations and balance it.	Lectures supported by laboratory experiments	Homework assignment, Examination and laboratory sheet
2.3	To interpret the ideal gas laws and illustrate chemical calculations.	Lecturing and oral discussion supported by laboratory experiments	Examination and laboratory report

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.4	To demonstrate ability to do oral communication and technical writing skills through writing and oral presentation of mini reports, operate electronic mail and Network in communicating with others.	• Oral participation • Group discussions and lab experiment and reports • Encourage students to use electronic mail to submit homework and assignments.	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks
3.0	**Values**		
3.1	To appraise coordination in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.	• Group discussion, assignments and homework • Lab-reports • Virtual labs and demonstrations	• Oral tests, lab performance, Lab-reports and sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Homework**	**All the semester**	**10 %**
2	**Laboratory**	**All the semester**	**30 %**
3	**Midterm Exam 1**	**Around 5th week**	**10 %**
4	**Midterm Exam 2**	**Around 8th week**	**10%**
5	**Final Exam**	**Around 11th– 12thweek**	**40 %**
6	**Total**		**100%**

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

F. Student Academic Counseling and Support

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

- **There are two office hours per week reserved by each staff member, planned on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counselling.**

G. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	• ***Chemistry***, Raymond CHANG, Mc Graw Hill, 10thEducation, 2010, ISBN 9780073511092.
Essential References Materials	• ***Chemistry,*** Steven S. Zumdahl and Susan A. Zumdahl, Houghton Mifflin, 7thEdition, 2006, ISBN: 061852844X • ***Laboratory Manual for Principles of General Chemistry***, J. A. Beran,, 7th Edition, John Wiley & Sons Inc., 2004.

Electronic Materials	• **Blackboard** • **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true** • **http://www.chem1.com/acad/webtext/virtualtextbook.html** • **http://www.shodor.org/UNChem/index.html**
Other Learning Materials	**Internal server: www. Elesevier.com**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

H. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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)

I. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**General Chemistry 2**
Course Code:	**CHM 102**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

A. Table of Contents

B. Course Identification

1. Credit hours: 4(2 Lectures, 2 Lab, 2 Tutorial)
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)**: CHM 101**
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**	60	**100%**
2	**Blended**		
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**40**
2	**Laboratory/Studio**	**20**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**60**

C. Course Objectives and Learning Outcomes

1. Course Description:

This introductory and general chemistry course covers fundamental observations, laws, and theories of chemistry at the basic level. Topics include atoms/molecules, stoichiometry, acids/bases, solutions, equilibrium, gases, solids, liquids, thermodynamics, the periodic table, and chemical bonding. The chemistry lab is taken in parallel with the course and covers the following basic experiments: density, mass-mass relationship, limiting reactant, acid-base titrations, solubility product, reactions in aqueous solution, Calorimetry and redox reactions. The module includes topics in experimental general chemistry relevant to the course.

2. Course Main Objective: ***This course is entended:***

- To familiarize students with basic knowledge of chemistry needed for higher level courses.
- To improve the students' understanding of the properties of substances in the light of trends in the properties of elements across the periodic table.
- To develop the students' appreciation of chemistry as an experimental science supported by theory as an interpretive and predictive tool.
- To create an awareness of the relevance of chemistry to other areas of industrial importance, and environmental issues among the students'.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recognize the basic concepts of physical, inorganic and analytical chemistry.**	**K1, K3**
1.2	**To name ionic and covalent compound using bonding concept and write Lewis structure of covalent compounds.**	**K1**
1.3	**To describe chemical experiments and define chemical equilibrium and factors affecting it.**	**K1, K2**
2	**Skills :**	
2.1	**To calculate the amount of heat transferred during a reaction..**	**S1, S3**
2.2	**To design experimental set up to measure heat change and acid-base constants, and assemble different electrochemical cells, perform chemical experiments during laboratory classes and field tasks.**	**S1, S2, S4**
2.3	**To define and explain the concepts of chemical equilibrium and factors affecting it.**	**S1, S3**
2.4	**To demonstrate ability to do oral communication and technical writing skills through writing and oral presentation of mini-reports, operate electronic mail and Network in communicating with others.**	**S1, S3**
3	**Values:**	
3.1	**To appraise coordination in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.**	**V1;V2**

D. Course Content

No	List of Topics	Contact Hours
	Topics to be covered (Lectures and Tutorial)	
1	**Thermochemistry**: First Law: State functions, change in enthalpy, work and heat, Enthalpy of chemical reactions, Calorimetry, Second Law: Entropy, Gibbs free energy, Free energy and chemical equilibrium.	**5**
2	**Entropy, free energy and equilibrium**: Spontaneous reactions, Entropy, State function, Entropy change of a system, Gibbs free energy, phase transition, Gibbs free energy and chemical equilibrium.	**5**
3	**Chemical equilibrium**: Chemical equilibrium, Law of mass action, Equilibrium constant, Equilibrium concentration, Le Chatelier's principal.	**5**
4	**Acid and Base**: Ion product of water, pH measurement, strong acid and base, weak acid and weak base, acid ionization constant, percent ionization, molecular structure and acid strength, acid-base properties of salts.	**5**
5	**Electrochemistry**: Redox reactions, Galvanic Cell, Standard reduction potential, spontaneities of Redox reactions, Cell Emf.	**4**
6	**Physical Properties of Solutions**: Type of solutions, A molecular view of the solution process, Concentration units, Effect of temperature on solubility, Effect of pressure on the solubility of gases.	**5**
7	**Chemical bonding**: Lewis Dot Symbols, The Ionic Bond, Lattice Energy of Ionic Compound, The Born-Haber Cycle for Determining Lattice Energies, The Covalent Bond, Electronegativity, Electronegativity and Oxidation Number, Writing Lewis Structures, Formal Charge and Lewis Structure, The Concept of Resonance, Exceptions to the Octet Rule, The Incomplete Octet, Odd-Electron Molecules, The Expanded Octet, Bond energy. Hybridization of Atomic Orbitals (sp3, sp2 & sp),	**8**

8	**Nuclear Chemistry**: Balancing nuclear equations, Nuclear stability and radioactive decay.	**3**
Topics to be covered (Laboratories)		
1	Safety and Laboratory equipment and measurements and How to make a report & Calorimeter calibration,	
2	Determination of heat of solution(endothermic-exothermic reaction)	**2**
3	Determination of specific heat of metals & Determination of heat of Neutralization	**2**
4	Determination of heat of Dilution	**2**
5	Chemical equilibrium: Effect of concentration & Chemical equilibrium: Effect of Temperature	**2**
6	Determination of acid pKa	**2**
7	Determination of iron by reaction with permanganate: Redox Titration	**2**
8	Daniel Cell	**2**
9	Determination of the reaction rate of sodium thiosulfate and hydrochloric acid	**2**
10	Factors affecting reaction rate	**2**
Total		**60**

E. 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**		
1.1	To recognize the basic concepts of physical, inorganic and analytical chemistry.	Lecturing	Short quizzes
1.2	To name ionic and covalent compound using bonding concept and write Lewis structure of covalent compounds.	Solving problems, Homework and assignment	Homework and assignment marks and written exams
1.3	To describe chemical experiments and define chemical equilibrium and factors affecting it.	Discussions, Laboratory classes	Quizzes and MCQs, laboratory report
2.0	**Skills**		
2.1	To differentiate between protons, neutrons and electrons.	Lecturing and oral discussion	Short quizzes and Multiples Choice Questions
2.2	To design experimental set up to measure heat change and acid constant and calculate the amount of heat transferred during a reaction and assemble different electrochemical cells, perform chemical experiments during laboratory classes and field tasks.	Lectures supported by laboratory experiments	Homework assignment, Examination and laboratory sheet
2.3	To define and explain the concepts of chemical equilibrium and factors affecting it.	Lecturing and oral discussion supported by laboratory experiments	Examination and laboratory report

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.4	To demonstrate ability to do oral communication and technical writing skills through writing and oral presentation of mini-reports, operate electronic mail and Network in communicating with others.	• Oral participation • Group discussions and lab experiment and reports • Encourage students to use electronic mail to submit homework and assignments.	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks
3.0	**Values**		
3.1	To appraise coordination in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.	• Group discussion, assignments and homework • Lab-reports • Virtual labs and demonstrations	• Oral tests, lab performance, Lab-reports and sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Homeworks**	**All the semester**	**10 %**
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3	**Midterm Exam 1**	**Around 5th week**	**20 %**
4	**Midterm Exam 2**	**Around 8th week**	**10%**
5	**Final Exam**	**Around 11th– 12thweek**	**40 %**
6	**Total**		**100%**

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

F. Student Academic Counseling and Support

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

- **There are 2 office hours per week reserved by each staff member, planned on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counselling.**

G. Learning Resources and Facilities

1. Learning Resources

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Electronic Materials	• **Blackboard** • **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true** • **http://www.chem1.com/acad/webtext/virtualtextbook.html** • **http://www.shodor.org/UNChem/index.html**
Other Learning Materials	**Internal server: www. Elesevier.com**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

H. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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)

I. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Organic Chemistry (1)**
Course Code:	**CHM 121**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**4 (2 Lectures, 2 Lab, 2 Tutorials)**
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)**:**	**General chemistry (1) –CHM 101**
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	60	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	20
2	Laboratory/Studio	20
3	Tutorial	20
4	Others (specify)	0
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

This course is an introduction to the chemistry of carbon. The concepts of bonding, structure, and classification of compounds by functional groups, as well as reactions of aliphatic hydrocarbons, alkyl halides, alcohols, and ethers are presented from a mechanistic viewpoint. Stereo-chemical principles are emphasized.

2. Course Main Objective

At the end of this course the student will be able to:

- **Determine the concepts of chemical bonding and hybridization for Organic Compunds.**
- **Name Aliphatic Organic Compounds and its derivatives according to IUPAC system.**
- **Describe preparation and reactions of Aliphatic Organic Compounds**
- **Recognize the types of organic reactions.**
- **Outline chemical behaviors of Aliphatic Organic Compounds.**

- **Recognize the Aromaticity System for Organic Componds.**
- **Use glassware and equipments in organic laboratory, and safely handle chemicals.**

3. Course Learning Outcomes

	CLOs	AlignedPLOs
1	**Knowledge and Understanding**	
1.1	**To name Organic Compound according to IUPAC system.**	**K1, K3**
1.2	**To recognize the chemical behavior and Stereochemistry of Aliphatic Organic Compounds.**	**K1,K2, S2**
1.3	**To list the basic reactions covered in the required basic organic chemistry course.**	**K3, S1**
2	**Skills :**	
2.1	**To differentiate between saturated and unsaturated organic compounds.**	**K1, K3, S1**
2.2	**To justify chemical reactivity with chemical structure**	**S1, S2, S3**
2.3	**To summarize synthesis and reactivity of aliphatic compounds**	**S1, S3**
2.4	**Operate Laboratory Instruments and and Perform chemical experiments during Laboratory Classes field tasks.**	**K1; S2; S4**
3	**Values:**	
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	**V1; V2**

C. Course Content

No	List of Topics	Contact Hours
1	**Atomic Structure**: The nucleus, Orbitals, Electron Configurations, Development of chemical bonding theory, Valence bond Theory, sp3, sp2, sp Hybrid orbitals and the structure of Methane, Ethane, Ethylene and acetylene, The Nature of the chemical bonds, Drawing Chemical Structures.	**3**
2	**Covalent Bonds:** Acids and Bases. Polar Covalent Bonds, Formal Charges, Resonance, Rules of Resonance Forms, Drawing for Resonance Forms, Acids and bases, The Brønsted-Lowry definition, Acid base Strength, Predicting Acid – base Reactions from *pKa* Values, Organic Acids and Organic bases, The Lewis Definition, Molecular Models. Noncovalent Interaction.	**3**
3	**Alkanes and Their Stereochemistry**: Functional Groups, Alkane and Isomers, Naming Alkanes, Properties of Alkanes, Conformation of Ethane, Conformations of Other Alkane.	**4**
4	**Cyclolkanes and Their Steriochemistry**: Naming Cycloalkanes, *Cis-Trans* Isomerism in Cycloalkanes, Conformations of cycloalkanes, Axial and Equatorial bonds in cycloalkane, Conformational Monosubstituted Cycloalkanes, Conformational Disubstituted Cycloalkanes, Conformations of PolyCyclic cyclohexanes.**Group 18** elements (Noble Gas) :Introduction, Occurrence, extraction and uses, Physical properties, NMR active nuclei, Compounds of xenon, Fluorides, Chlorides, Oxides, Oxofluorides, Other compounds of xenon, Compounds of krypton and radon	**4**
5	**An Overview of Organic Reactions:** Kinds of organicreactions, How	**3**

	organic reaction occur, Mechanisms, Radical reactions, Polar reaction, Using curved Arrows in polar reactions Mechanisms, Describing a Reaction (Intermediates).	
6	**Alkenes:** Structure and Reactivity, Industrial Preparation and Use of Alkenes, Calculating Degree of Unsaturation, Naming Alkenes, Sequence Rules: E, Z Designation Stability of Alkenes, Electrophilic Addation Reactions of Alkenes, Orintation of Electrophilic Additions: Markovnikov's rule, Carbocation Structure and Stability, The Hammond Postulate, Evidence for the Mechanism of Electrophilic Additions, Carbocations Rearrangements.	**3**
7	**Reactions and Synthesis of Alkenes**; Preparations of alkenes; A Preview of Elimination Reactions, Addition of Halogens to Alkenes, Addition of Hypohalous Acids of Alkenes. Addition of water to alkenes (Oxy-mercuration, hydroboration), Addition of Carbenes to alkenes, Reduction of Alkenes, Oxidation of Alkenes (Epoxidation, Cleavage to carbonyl Compounds), Radical Additions to Alkenes; Biological Addition of Radicals to alkenes.	**3**
8	**Alkynes**: Naming Alkynes, Preparation of alkynes, (Elimination Reactions of Dihalides); Reactions of Alkyne (Addition of HX and X2); Hydration of Alkynes); Reduction of Alkynes; Oxidative Cleavage of alkynes: Alkyne Acidity (Formation of Acetylide Anions); Alkylation of Acetylide Anions, An Introduction of Organic Synthesis.	**3**
9	**Organohalids**: Naming alkyl halides, Structure of Alkylhalides, Preparing of Alkyl Halides from Alkanes (Radical Halogenations), Preparation of Alkylhalides from Alkenes (Allylic Bromination), Stability of the Allyl Radicals, Preparaton of Alkyl Halidse from Alcohols, Reactions of Alkyl Halides (Grignard Reagents), Organometallic Coupling Reactions, Oxidation and Reduction inOrganic Chemistry.	**4**
10	**Benzene and aromaticity**: Names of aromatic hydrocarbons, Disubstituted benzenes, Structure and stability of benzene, Molecular orbital description of benzene, Aromaticity and Huckel 4n+2 rule, Aromatic heterocycles	**3**
11	**Reactions of Alkyl Halides: Nucleophilic Substitutions and Eliminations:** The Discovery of Nucleophilic Substitution Reactions, The SN2 Reaction, Characteristics of the SN2 Reaction, The SN1 Reaction, Characteristics of the SN1 Reaction, Biological Substitution Reactions, Elimination Reactions: Zaitsev's Rule, The E2 Reaction and the Deuterium Isotope Effect, The E2 Reaction and Cyclohexane Conformation, The E1 and E1cB Reactions, Biological Elimination Reactions, A Summary of Reactivity: SN1, SN2, E1, E1cB, and E2.	**5**
12	**Revisions.**	**2**
Total		**40**
Topics to be covered (Laboratories)		
Lab 01	Identification of Organic Compounds; Physical Character, Solubility, Melting Points, Boiling Points. (Physical Properties).	**2**
Lab 02	Re-crystallization.	**2**
Lab 03	Chromatography (Thin Layer Chromatography)	**2**

Lab.04	Distillation	**2**
Lab05	Classification of organic compounds, identification of Aromatic and aliphatic hydrocarbons	**2**
Lab 0 6	Differentiation between alkane, alkene	**2**
Lab 07	Identifications and differentiation of alcohol (primary, secondary, tertiary alcohols) and Phenols	**2**
Lab 08	Identification and differentiation of aldehydes and ketones	**2**
Lab 09	Identification and differentiation of carboxylic acid as aromatic and aliphatic	**2**
Lab 10	Identification and differentiation of amines	**2**
Total		**20**

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1.0	**Knowledge and Understanding**		
1.1	**To name Organic Compound according to IUPAC system.**	▪ Six hours are weekly containing lectures and laboratory activities. ▪ A Private study including home exam.	**To name Organic Compound according to IUPAC system.**
1.2	**To recognize the chemical behavior and Stereochemistry of Aliphatic Organic Compounds.**	▪ Six hours are weekly containing lectures, and group discussion ▪ Laboratory activities and discussion.	**To recognize the chemical behavior and Stereochemistry of Aliphatic Organic Compounds.**
1.3	**To list the basic reactions covered in the required basic organic chemistry course.**	▪ Six hours are weekly for laboratory activities ▪ Think talk, and review the basic reactions in the organic chemistry course	**To list the basic reactions covered in the required basic organic chemistry course.**
2.0	**Skills :**		
2.1	**To differentiate between saturated and unsaturated organic compounds.**	▪ Introduce some solved and unsolved examples of differentiation between Saturated and Unsaturated Organic Compounds	**To differentiate between saturated and unsaturated organic compounds.**
2.2	**To justify chemical reactivity with**	▪ Group Discussions	**To justify chemical**

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
	chemical structure	and Laboratory Experiments	**reactivity with chemical structure**
2.3	**To summarize synthesis and reactivity of aliphatic compounds**	▪ Lectures and Oral Discussions. ▪ Brain storming Exercises	**To summarize synthesis and reactivity of aliphatic compounds**
2.4	**Operate Laboratory Instruments and and Perform chemical experiments during Laboratory Classes field tasks.**	▪ Group Discussions and Laboratory Experiments	**To justify chemical reactivity with chemical structure**
3.0	**Values**		
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	Group Discussions	• Oral Discussion. • Group Discussion and Assignments

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Home Exams**	**All the semester**	**10 %**
2	**Laboratory**	**All the semester**	**30 %**
3	**Midterm Exam**	**Around 5th -6th week**	**20 %**
5	**Final Exam**	**Around 11th– 12th week**	**40 %**
6	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Organic Chemistry*****,** John E. McCurry. Mary Finch (Cengage Group), 8ed (2012), | ISBN-10: 0495118370 | ISBN-13: 978-0495118374. • ***Vogel's' Textbook of Practical Organic Chemistry*****, Vogel, A.I., Tatchell, A.R. , Furnis, B.S , Smith, P.W.G,** Longman Group UK Limited, 5th Ed. 1989 ISBN 978-0-582-46236-6
Essential References Materials	• ***Organic Chemistry*****.** Paula Yurkanis Bruice, 2Ed, PRENTICE HALL, Upper saddle River New Jersey 07458), 1998, ISBN-10: 0321803221. • ***Organic Chemistry*****, Morrison, R. T.; Boyd, R. N. ,** 6th edition, Prentice Hall of India, (1996), ISBN-10: 0136436692.
Electronic Materials	• **Blackboard** • **http://www.chemweb.com** • **http://www.chemistry.com** • **http://www.orgsyn.org**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.** • **Each Laboratory should be equipped with maximum 25 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms and laboratories are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner

Evaluation Areas/Issues	Evaluators	Evaluation Methods
		checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Inorganic Chemistry (1)**
Course Code:	**CHM 211**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 4 (2 Lectures, 3 Lab, 1 Tutorials)
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: Level 3 / Year 1
4. Pre-requisites for this course: General Chemistry (1) - CHM 101
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	60	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	20
2	Laboratory/Studio	30
3	Tutorial	10
4	Others (specify)	0
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

In this module students will study the elements of the periodic table in their different groups, alkali metals, halogens, s and p-block, inert gases, relation of properties with the position in the periodic table. The experimental part of this module deals with the identification of some anions and cations.

2. Course Main Objective

At the end of the course, Students should be able to:

- ***Gain knowledge of the basic information of s and p block elements and inert gases.***
- ***Acquire methods of preparation of s and p block elements and their uses.***

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To memorize the different groups of elements.**	**K1; K3**
1.2	**To recognize the properties and to describe the methods of preparation of elements and compounds of groups I-VIIA.**	**K1; K3; S2**
1.3	**To list different uses and applications of inorganic compounds.**	**K1; S1**
2	**Skills :**	
2.1	**To estimate the specific properties of elements according to their position in the periodic table.**	**K1; S1**
2.2	**To differentiate between groups of elements and their respective compounds.**	**S3**
2.3	**To predict the components of ionic compounds.**	**S1; S3**
2.4	**To diagram and illustrate experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	**S2; S3; S4**
3	**Values:**	
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	**V1;V2**

C. Course Content

No	List of Topics	Contact Hours
1	• **Review on The elements** and their compounds: Periodic trends, Valence electron configurations, • **Hydrogen**: The hydrogen ion (proton), The hydride ion, Isotopes of hydrogen, protonium and deuterium, Deuterated compounds, Tritium, Dihydrogen. • **Group 1**: The alkali metals and their compounds: Introduction, Occurrence, extraction and uses, Extraction, Major uses of the alkali metals and their compounds, Physical properties and General properties. • **Group 2**: The alkali earth metals and their compounds: Introduction, Occurrence, extraction and uses, Major uses of the group 2 metals and their compounds, Physical properties and General properties.	**10**
2	• **Group 13**: elements and their compounds: Introduction, Occurrence, extraction and uses, Major uses of the group 13 elements and their compounds, Physical properties, Electronic configurations and oxidation states. • **Group 14**: elements and their compounds: Introduction, Occurrence, extraction and uses, Occurrence, Extraction and manufacture, Uses, Physical properties, Ionization energies and cation formation, Some energetic and bonding considerations, Allotropes of carbon, Graphite and diamond: structure and properties.	**6**
3	• **Group 15**: elements and their compounds: Introduction, Occurrence, extraction and uses, Physical properties, Bonding considerations, Nitrogen, Phosphorus, Arsenic, antimony and bismuth. • **Group 16**: elements (Chalcogen) and their compounds: Introduction, Occurrence, extraction and uses, Physical properties and bonding considerations.	**6**

4	• **Group 17** elements (Halogens) and their compounds: the Introduction, Fluorine, chlorine, bromine and iodine, Astatine, Occurrence, extraction and uses, Physical properties and bonding considerations, NMR active nuclei and isotopes as tracers, The elements, Difluorine, Dichlorine, dibromine and diiodine,, Hypofluorous acid, Oxoacids of chlorine, bromine and iodine and their aqueous solution chemistry • **Group 18** elements (Noble Gas) :Introduction, Occurrence, extraction and uses, Physical properties, NMR active nuclei, Compounds of xenon, Fluorides, Chlorides, Oxides, Oxofluorides, Other compounds of xenon, Compounds of krypton and radon	**8**
Total		**30**

Topics to be covered (Laboratories)		
Lab 01	**Safety and Laboratory equipment's and measurements and How to make a report**	**3**
Lab 02	**Qualitative Analysis of HCl Group (CO_3^{-2}, HCO_3^-, S^{-2}, $S_2O_3^{-2}$, NO_2^- and SO_3^{-2})**	**3**
Lab 03	**Qualitative Analysis of H_2SO_4 Group, (Cl^-, Br^-, I^- and NO_3^-)**	**3**
Lab 04	**Qualitative Analysis of Miscellaneous Group, (SO_4^{-2}, $B_4O_7^{-2}$ and PO_4^{-3})**	**3**
Lab 05	**Qualitative Analysis of Group I (Pb^{2+}, Hg+ and Ag^+)**	**3**
Lab 06	**Qualitative Analysis of Group IIA (Cu^{2+}, Hg^{2+} , Cd^{2+} and Bi^{3+})**	**3**
Lab 07	**Qualitative Analysis of Group IIB (Sn^{2+}, Sb^{3+} , Sb^{5+} , As^{3+} and As^{5+})**	**3**
Lab 08	**Qualitative Analysis of Group III, Al^{3+}, (Fe^{2+}, Mn^{2+}), (Co^{2+}, Ni^{2+}) and (Zn^{2+}& Cr^{3+})**	**3**
Lab 09	**Qualitative Analysis of Group IV (Ba^{2+}, Ca^{2+} and Sr^{2+})**	**3**
Lab 10	**Qualitative Analysis of Group V (Mg^{2+}, K^+ and Na^+)**	**3**
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 and Understanding**		
1.1	**To memorize the different groups of elements.**	Lectures	quizzes
1.2	**To recognize the properties and to describe the methods of preparation of elements and compounds of groups I-VIIA.**	▪ Lectures and group discussion Lectures and laboratory experiments	▪ Homework Exams and laboratory reports
1.3	**To list different uses and applications of inorganic compounds.**	Lectures and tutorials	▪ Quizzes and homework
2.0	**Skills**		
2.1	**To estimate the specific properties of elements**	Lectures and tutorials	Quizzes and homework

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	according to their position in the periodic table.		
2.2	**To differentiate between groups of elements and their respective compounds.**	Group discussions and laboratory experiments	Oral questions marks and laboratory reports
2.3	**To predict the components of ionic compounds.**	Brain storming	MCQs
2.4	**To diagram and illustrate experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	▪ **Group discussion and assignments** ▪ **Demonstrations and laboratory manuals** ▪ **Presentations, demonstrations and virtual labs.** • **Encourage studens to use electronic mail to submit homeworks and assignments**	▪ **Oral tests and assignments marks** ▪ **Laboratory performance** ▪ **Laboratory performance and reports** • **Assignments and homework**
3.0	**Values**		
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	• **Group discussions** • **Homework** • **Mini reports** • **Virtual labs and demonstrations**	• **Presentation marks** • **Oral tests and lab sheets** • **Assessments and homework** • **Laboratory performance** • **Laboratory reports and sheet**

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Midterm 1**	**5th/ 6th week**	**10 %**
	Midterm 2	**8th/9th weak**	**10%**
2	**Quizzes, Home Works, class participation, and mini projects**	**During the semester**	**10 %**
3	**Laboratory**	**All the semester**	**30 %**
4	**Final Exam**	**11th - 12th week**	**40 %**

#	Assessment task*	Week Due	Percentage of Total Assessment Score
5	**Total**	**All weeks**	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Inorganic Chemistry***, Catherine E. Housecroft and Alan G. Sharpe,. 2nd ED. Pearson Education Limited, Essex CM20 2JE, England, 2005 (ISBN: 0130-39913-2).
Essential References Materials	• Inorganic Chemistry, Atkins, P., and Overton, T., Rourke, J., Weller, M., Armstrong, F. and Hagerman, M. 5th Ed. New York, NY: W.H. Freeman and Company, 2010 (ISBN: 978-1-42-921820-7). • Laboratory Manual for Principles of General Chemistry, J. A. Beran,, 9th Edition, John Wiley & Sons Inc., 2004. (ISBN:9780470647899). •
Electronic Materials	▪ **Blackboard** • **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true** • **http://www.chem1.com/acad/webtext/virtualtextbook.html** ▪ **http://www.shodor.org/UNChem/index.html**
Other Learning Materials	**None**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each classroom is equipped with PC and retro projector with a maximum of 25 students.** • **Each Laboratory should be equipped with maximum 25 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**

Item	Resources
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

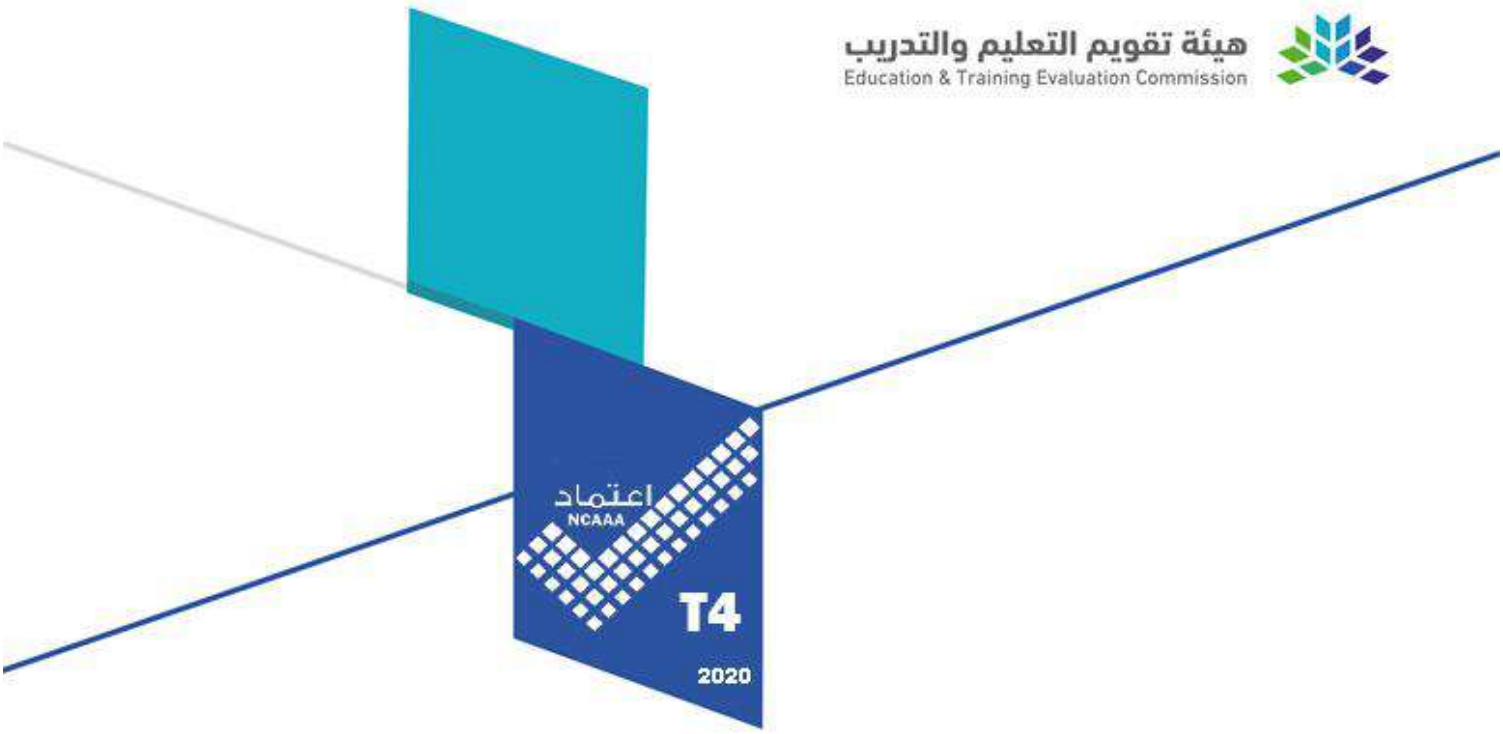
Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Inorganic Chemistry (2)**
Course Code:	**CHM 212**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 4 (3 Lectures, 3 Lab and Tutorials)
2. Course type **a.** University ☐ College ☐ Department ✓ Others ☐ **b.** Required ✓ Elective ☐
3. Level/year at which this course is offered: Level 4 / Year 2
4. Pre-requisites for this course: Inorganic Chemistry (1) - CHM 1211
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	60	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	30
2	Laboratory/Studio	30
3	Tutorial	0
4	Others (specify)	0
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

Topics covered in the course include Coordination Compounds and their magnetic properties, theories regarding complexes geometries with their electronic configuration, types of ligands and properties. The course will be provide the students with Basic information for transition metals including methods of preparation, uses of elements and compounds.

2. Course Main Objective

At the end of the course, Students should be able to:

- ***Understanding Coordination compounds, their magnetic properties, theories regarding complexes geometries and their electronic configuration,***
- ***Understanding ligands, their types and properties.***
- ***Basic information about transition metals and analytical chemistry including***

methods of preparation, uses of elements and compounds.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To list the general characteristics of transition elements and identify a number industrial and metallurgical process.**	**K1; K2; K3;**
1.2	**To describe the Crystal Field Theory and the Molecular orbital theory**	**K1**
1.3	**To name complexes made of a central atoms and ligands and to recognize the origin of metals magnetism**	**K1; K3**
2	**Skills :**	
2.1	**To differentiate between paramagnetic, diamagnetic and ferromagnetic and anti- ferromagnetic compounds and to summarize the common physical and chemical properties of s and d elements.**	**S1; S3**
2.2	**To draw the electronic structures of transition metal complexes and to interpret electronic absorption spectra of complexes**	**S1; S2 and S3**
2.3	**To prepare standard solution using different laboratory equipment's**	**S2; S3**
2.4	**To diagram and illustrate experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	**S2; S3; S4**
3	**Values:**	
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	**V1;V2**

C. Course Content

No	List of Topics	Contact Hours
1	**Werner's Coordination Theory**, ligand classification, Nomenclature of Coordination Compounds Complex formation, Variable oxidation states, Electroneutrality principle **Isomerism in d-block metal complexes**: Structural isomerism: ionization isomers, Structural isomerism: hydration isomers, Structural isomerism: coordination isomerism, Structural isomerism: linkage isomerism, Structural isomerism: polymerization isomerism, Stereoisomerism: geometrical isomers, Stereoisomerism: optical isomers. Coordination numbers, Factors Affecting Coordination Number, The Kepert model, Coordination number 2-7 , stability of complexes, Preparation of coordination complexes, Detection of complexes.	**6**
2	**d-Block chemistry:** general considerations: Topic overview, Ground state electronic configurations, d-Block metals versus transition elements, Electronic configurations, Physical properties, The reactivity of the metals, Characteristic properties: a general perspective, Colour and Paramagnetism.	**6**
3	**Scandium group:** characterization, oxidation states, extraction, compounds, chemical reactions, oxidation states, extraction, compounds, separation, Titanium group: characterization, oxidation states, extraction, compounds, chemical reactions, separation, Vanadium Group: characterization, oxidation states, extraction, compounds, chemical reactions, separation, Chromium group: characterization, oxidation states, extraction, compounds, chemical reactions, separation, Manganese group: characterization, oxidation states, extraction,	**12**

	compounds, chemical reactions, separation, Iron group: characterization, oxidation states, extraction, compounds, chemical reactions, separation, Cobalt group: characterization, oxidation states, extraction, compounds, chemical reactions, separation, Nickel group, characterization, oxidation states, extraction, compounds, chemical reactions, separation, Copper group: characterization, oxidation states, extraction, compounds, chemical reactions, separation, Zinc group: characterization, oxidation states, extraction, compounds, chemical reactions, separation.	
4	**The f-block metals:** lanthanoids and actinoids: Introduction, f -Orbitals and oxidation states, Atom and ion sizes, The lanthanoid contraction, Coordination numbers, Sources of the lanthanoids and actinoids, occurrence and separation of the lanthanoids, The actinoids, Lanthanoid metals, Inorganic compounds and coordination complexes of the lanthanoids, Halides, Hydroxides and oxides, Complexes of Ln(III), The actinoid metals, Inorganic compounds and coordination complexes of thorium, uranium and plutonium, Thorium, Uranium, Plutonium.	**6**
Total		**30**
Topics to be covered (Laboratories)		
Lab 01	Determine M & S for Mg^{2+}, Zn^{2+} and Pb^{2+}.	**3**
Lab 02	Determine M & S for Cu^{2+}, Ni^{2+} and Ca^{2+} & Determine M & S for $Co^{2+}$and Zn^{2+}	**3**
Lab 03	Determine M & S for Al^{3+}, Ni^{2+} and Mg^{2+}	**3**
Lab 04	Determine M & S for Fe^{3+} and Zn^{2+}	**3**
Lab 05	Analysis of Mg^{2+} + Zn^{2+} and Mg^{2+} + Ni^{2+} mixtures & Analysis of Mg^{2+} + Zn^{2+} and Mg^{2+} + Zn^{2+} + Cu^{2+} mixtures	**3**
Lab 06	Preparation of chloropentammine cobalt(III) chloride	**3**
Lab 07	I basic cations Separation of group & II basic cations separation of group	**3**
Lab 08	III basic cations Separation of group	**3**
Lab 09	IV basic cations Separation of group	**3**
Lab 10	V basic cations Separation of group	**3**
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 and Understanding**		
1.1	**To list the general characteristics of transition elements and identify a number industrial and metallurgical process.**	**Lectures**	**Quizzes**
1.2	**To describe the Crystal Field Theory and the Molecular orbital theory**	**Group discussion and laboratory experiments**	• **Homework laboratory reports**

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.3	To name complexes made of a central atoms and ligands and to recognize the origin of metals magnetism	Lectures	Exams
2.0	**Skills**		
2.1	To differentiate between paramagnetic, diamagnetic and ferromagnetic and anti-ferromagnetic compounds and to summarize the common physical and chemical properties of s and d elements.	Lecturing and group discussion	• Quizzes • oral exercises Exam
2.2	To draw the electronic structures of transition metal complexes and to interpret electronic absorption spectra of complexes	• Tutorials Group discussion	• Homework Oral tests
2.3	To prepare standard solution using different laboratory equipment's	Lab experiments	Lab reports
2.4	To diagram and illustrate experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.	• Group discussion and assignments • Demonstrations and laboratory manuals • Presentations, demonstrations and virtual labs. • Encourage students to use electronic mail and blackboard to submit homeworks and assignments	▪ Oral tests and assignments marks ▪ Laboratory performance ▪ Laboratory performance and reports • Assignments and homework
3.0	**Values**		
3.1	To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.	• Group discussions • Homework • Mini reports • Virtual labs and demonstrations	• Presentation marks • Oral tests and lab sheets • Assessments and homework • Laboratory performance • Laboratory reports and sheet

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	10 %
2	Midterm 2	8th/9th weak	10%
3	Quizzes, Home Works, class participation, and mini projects	During the semester	10 %
4	Laboratory	All the semester	30 %
5	Final Exam	11th -12th week	40 %
6	Total	All weeks	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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Inorganic Chemistry***, Gary L. Miessleand Donald A. Tarr. 4th Edition, 2010, Publisher: Prentic Hall:, 2010 ISBN-10:0136128661 • ***Advanced Inorganic Chemistry: A Comprehensive Text,***F. A. Cotton, S. G. Wilkinson 3rd Edition, 1972. Published by John Wiley & Sons Inc. ISBN 13: 9780471175605
Essential References Materials	• ***Advanced Inorganic Chemistry: A Comprehensive Text***, F. A. Cotton, & G. Wilkinson, 3rd Edition, Published by New York: Interscience Publishers Inc., New York. • ***Quantitative Chemical Analysis,*** Daniel C., Harris, 8th Edition, 2010. W. H. Freeman;: ISBN-10: 1429218150
Electronic Materials	▪ **Blackboard** ▪ **www. Elesevier.com**

Other Learning Materials	**Comprehensive Inorganic Chemistry**. Sulekh Chandra, New Age International Limited Publishers, New Delhi, 2004 Descriptive inorganic chemistry, Rayner-Canham, Geoff., Publisher: W.H. Freeman, New York, 2006

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each classroom is equipped with PC and retro projector with a maximum of 25 students.** • **Each Laboratory should be equipped with maximum 25 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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	**Council of Chemistry Department**
Reference No.	
Date	**March, 2020**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Organic Chemistry (2)**
Course Code:	**CHM 221**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**4 (2 Lectures, 2 Lab, 2 Tutorials)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 3 / Year 1**
4. Pre-requisites for this course (if any)**:**	**Organic chemistry (1) –CHM 121**
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**	**60**	**100 %**
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**20**
2	**Laboratory/Studio**	**20**
3	**Tutorial**	**20**
4	**Others** (specify)	**0**
	Total	**60**

B. Course Objectives and Learning Outcomes

1. Course Description

The course covers an introduction to Steriochemistry, the Electrophilic Aromatic Substitution, Organic Functional Groups of Alcohols, Aldehydes, Ketones, Ethers, Epoxides, Carboxylic Acids, Carboxylic Acid Derivatives, Amines, Biomolecules as Amino Acids, Protein and Lipids will be included. A mechanistic Approach to Reactions will be in Short cut. The Chemistry Laboratory is taken simultaneously with the course and cover the following experiments which is in direct relation with the course.

2. Course Main Objective

At the end of this course the student will be able to:

- **To define the Aromaticity of Aromatic Systems.**
- **To list of Chemical Behavior of Aromatic Systems to a variety of reagents.**
- **To outline the Functional Groups of Organic Compounds.**

- To state the Reactivity of Functional Groups.
- To recognize the potential importance of the Organic Chemistry in biomolecules
- To name Organic Compounds according to IUPAC system.
- Use glassware and equipment's in Organic Laboratory, and safely handle chemicals.

3. Course Learning Outcomes

	CLOs	AlignedPLOs
1	**Knowledge and Understanding**	
1.1	To define the Aromaticity of Aromatic Systems, and its Chemical Behavior to a variety of reagents.	K1; K3;
1.2	To outline the Functional Groups of Organic Compounds and their reactivity.	K1; K3; S2
1.3	To recognize the Potential importance of the Organic Chemistry in Biomolecules	K3; S1
2	**Skills :**	
2.1	To compare between the Functional Groups in terms of the reactivity and structures.	K1; K3; S1; S2
2.2	To predict the behavior of Functional Group towards Chemical Reaction.	S1; S2; S3
2.3	To write a simple mechanism based Chemical Reactivity of Functional Group.	S1; S3
2.4	Operate Laboratory Instruments and and Perform chemical experiments during Laboratory Classes field tasks.	K1; S2; S4
3	**Values:**	
3.1	To demonstrate responsibility for their own learning and motivate for Team Work.	V1; V2

C. Course Content

No	List of Topics	Contact Hours
1	**Benzene and aromaticity**: Names of aromatic hydrocarbons, Disubstituted benzenes, Structure and stability of benzene, Molecular orbital description of benzene, Aromaticity and Huckel 4n+2 rule, Aromatic heterocycles	3
2	**Chemistry of Benzene**: Brominating of Aromatic Rings, Other Aromatic Substitutions, and Alkylation of Aromatic Rings: The Friedel–Crafts Reaction, Acylation of Aromatic Rings, Substituent Effects in Aromatic Rings, An Explanation of Substituent Effects. Tri-substituted Benzenes: Additivity of Effects, Nucleophilic Aromatic Substitution, Benzene, Oxidation of Aromatic Compounds, Reduction of Aromatic Compounds, Synthesis Strategies.	5
3	**Alcohols and Phenols:** Naming Alcohols, Properties of Alcohols and Phenols: Hydrogen Bonding, Properties of Alcohols and Phenols: Acidity and Basicity, Preparation of Alcohols: an Overview, Alcohols from Reduction of Carbonyl Compounds, Alcohols from Reaction of Carbonyl Compounds with Grignard Reagents, Some Reactions of Alcohols, Oxidation of Alcohols, Protection of Alcohols, Preparation and Uses of Phenols, Reactions of Phenols, Spectroscopy of Alcohols and Phenols.	5

4	**Ethers and Epoxides; Thiols and Sulfides**: Naming Ethers, Structure, Properties, and Sources of Ethers, The Williamson Ether Synthesis, Alkoxy-mercuration of Alkenes, Reactions of Ethers: Acidic Cleavage, Reactions of Ethers: Claisen Rearrangement, Cyclic Ethers: Epoxides, Ring-Opening Reactions of Epoxides, Crown Ethers, Thiols and Sulfides,	**4**
5	**Aldehydes and Ketones**: Naming Aldehydes and Ketones, Preparation of Aldehydes and Ketones, Oxidation of Aldehydes and Ketones, Nucleophilic Addition Reactions of Aldehydes and Ketones, Relative Reactivity of Aldehydes and Ketones, Hydration, Cyanohydrin Formation, Imine and Enamine Formation, Nucleophilic Addition of Hydrazine: The Wolff–Kishner Reaction, Nucleophilic Addition of Alcohols: Acetal Formation.	**4**
6	**Carboxylic Acids and Nitriles**: The Importance of Carboxylic Acids (RCO_2H), Naming Carboxylic Acids and Nitriles, Structure and Physical Properties of Carboxylic Acids, Dissociation of Carboxylic Acids, Substituent Effects on Acidity, Substituent Effects in Substituted Benzoic Acids, Substituent Effects in Substituted Benzoic Acids, Preparation of Carboxylic Acids, Reactions of Carboxylic Acids: An Overview, Reduction of Carboxylic Acids, Chemistry of Nitriles, Preparation of Nitriles by Dehydration, Hydrolysis: Conversion of Nitriles into Carboxylic Acids.	**4**
7	**Carboxylic Acid Derivatives and Nucleophilic Acyl Substitution Reactions**: Naming Carboxylic Acid Derivatives, Nucleophilic Acyl Substitution, Nucleophilic Acyl Substitution Reactions of Carboxylic Acids, Chemistry of Acid Halides, Chemistry of Acid Anhydrides, Chemistry of Esters, Chemistry of Amides, Thioesters and Acyl Phosphates: Biological Carboxylic Acid Derivatives, Polyamides and Polyesters: Step-Growth Polymers, Spectroscopy of Carboxylic Acid Derivatives.	**4**
8	**Amines**: Naming Amines, Structure and Bonding in Amines, Properties and Sources of Amines, Basicity of Amines, Basicity of Substituted Arylamines, Synthesis of Amines, Reactions of Arylamines, Tetraalkylammonium Salts as Phase-Transfer Catalysts,	**4**
9	**Stereochemistry:** Enantiomers and the Tetrahedral Carbon, The Reason for Handedness in Molecules (Chirality Optical Activity) Pasteur's discovery of Enantiomers, Sequence Rule for Specifying Configuration, Diastereomers, Meso-Compounds, Racemic Mixtures and the Resolution of Enantiomers, Stereochemistry of Reactions: addition of H_2O to an Achiral Alkene, Sterochemistry of Reactions: addition of H_2O to an a chiral Alkene, Chirality at nitrogen, phosphorus and Sulfur, Chirality in Nature and Chiral Environments.	**4**
10	**Revision**	**3**
Total		**40**
Topics to be covered (Laboratories)		
Lab 01	**Nitration of Aromatic Compounds: Preparation of nitro benzaldehyde) & Sulfonation of Aromatic Compounds.**	**2**
Lab 02	**Nucleophilic Substitution Reactions of Alkyl Halides**	**2**
Lab 03	**Reactivity of aldehyde with ketone in the presence of base, Aldol Condensation & Synthesis of oximes: Reaction of carbonyl compounds with hydroxylamine**	**2**
Lab 04	**Preparation of Asprine**	**2**
Lab. 05	**Oxidation of Benzaldehyde-Green Chemistry**	**2**

Lab 0 6	**Mannich Reaction: The acid-catalyzed reaction of an enolizable aldehyde or ketone with an imminium ion, followed by a base to give a β-aminoaldehyde of a β-aminoketone**	**2**
Lab 07	**Shiff base: Reaction of N-nucleophiles with aldehyde**	**2**
Lab 08	**Saponification, Preparation of Soap**	**2**
Lab 09	**Synthesis of acetanilidine; Reaction of aniline with acetic anhydride**	**2**
Lab 10	**Synthesis of azo dye: Coupling between 2-naphthol and 4-aminobenzenesulfonic acid**	**2**
Total		**20**

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1.0	**Knowledge and Understanding**		
1.1	**To define the Aromaticity of Aromatic Systems, and its Chemical Behavior to a variety of reagents.**	▪ Six hours are weekly containing lectures and laboratory activities. ▪ A Private study including home exam.	▪ Quizzes Assignments ▪ Discussions. ▪ Participation.
1.2	**To outline the Functional Groups of Organic Compounds and their reactivity.**	▪ Six hours are weekly containing lectures, and group discussion ▪ Laboratory activities and discussion.	▪ Quizzes Assignments. • Oral Discussion marks • Laboratory Reports
1.3	**To recognize the Potential importance of the Organic Chemistry in Biomolecules**	▪ Six hours are weekly for laboratory activities ▪ Think talk, and review Organic Chemistry in Biomolecules	▪ Quizzes ▪ Home exam ▪ Oral Discussions.
2.0	**Skills :**		
2.1	**To compare between the Functional Groups in terms of the reactivity and structures.**	▪ Introduce some solved and unsolved examples of Comparison between Functional Groups of Organic Compounds	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Participation ▪ Oral Discussion, ▪ Laboratory Reports ▪ Home Exam.
2.2	**To predict the behavior of Functional Group towards Chemical Reaction.**	▪ Group Discussions and Laboratory Experiments	• Questions in Lectures. • Laboratory Reports

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
			• Short Quizzes and Exams. • Oral Discussion
2.3	**To write a simple mechanism based Chemical Reactivity of Functional Group.**	▪ Lectures and Oral Discussions. ▪ Brain storming Exercises	▪ Questions in Lectures. ▪ Short Quizzes and Exams.
2.4	**Operate Laboratory Instruments and and Perform chemical experiments during Laboratory Classes field tasks.**	▪ Encourage the students to use the Chemicals Glass wares and Instruments with caring and safety	▪ Assignments and Laboratory Report.
3.0	**Values:**		
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	▪ Brain Storms Exercises ▪ Group Discussion	• Oral Discussion. ▪ Group Discussion and Assignments

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Home Exams**	**All the semester**	**10 %**
2	**Laboratory**	**All the semester**	**30 %**
3	**Midterm Exam1**	**Around 5th week**	**10 %**
4	**Midterm Exam 2**	**Around 8th week**	**10 %**
5	**Final Exam**	**Around 11th– 12th week**	**40 %**
6	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Organic Chemistry*****,** John E. McCurry. Mary Finch (Cengage Group), 8ed (2012), | ISBN-10: 0495118370 | ISBN-13: 978-0495118374. • ***Vogel's' Textbook of Practical Organic Chemistry*****, Vogel, A.I., Tatchell, A.R. , Furnis, B.S , Smith, P.W.G,** Longman Group UK Limited, 5th Ed. 1989 ISBN 978-0-582-46236-6
Essential References Materials	• ***Organic Chemistry*****.** Paula Yurkanis Bruice, 2Ed, PRENTICE HALL, Upper saddle River New Jersey 07458), 1998, ISBN-10: 0321803221. • ***Organic Chemistry*****, Morrison, R. T.; Boyd, R. N. ,** 6th edition, Prentice Hall of India, (1996), ISBN-10: 0136436692.
Electronic Materials	• **Blackboard** • **http://www.chemweb.com** • **http://www.chemistry.com** • **http://www.orgsyn.org**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.** • **Each Laboratory should be equipped with maximum 25 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms and laboratories are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Quality of learning resources	Students	**Indirect:** Second examiner checklist- Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Organic Compounds Spectroscopy**
Course Code:	**CHM 224**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**3 (3 Lectures, 0 Lab, 0 Tutorials)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 6 / Year 2**
4. Pre-requisites for this course (if any):	**Organic chemistry (2) –CHM 221**
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**	**30**	**100%**
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

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

B. Course Objectives and Learning Outcomes

1. Course Description

This course provides students with an Introduction for Organic Compounds Spectroscopy, which covers all techniques: UV-vis spectroscopy, infrared spectroscopy, ^{1}H and ^{13}C NMR spectroscopy, with practice problems

2. Course Main Objective

At the end of this course the student will be able to:

- To recognize the basic spectroscopy of Organic Compounds
- To describe the spectroscopic data of Organic Compounds by determination the Functional Group and number of protons and carbons.
- To outline scientific methods for identifying and elucidating organic compounds.
- To interpret the structure of organic compounds from spectroscopic data.

To define factors influence the chemical structure

3. Course Learning Outcomes

	CLOs	AlignedPLOs
1	**Knowledge and Understanding**	
1.1	**To recognize the basic spectroscopy of organic compounds.**	**K1; K3;**
1.2	**To describe the spectroscopic data of organic compounds by determination the functional group and number of protons and carbons.**	**K1; K3; S2; C2**
1.3	**To interpret the structure of Organic Compounds from spectroscopic data with defining factors influence the chemical structure**	**K3; S1**
2	**Skills:**	
2.1	**To analyze information related to applied organic chemistry.**	**K1; K3; S1; S3**
2.2	**To interpret data and results through analytical logical thinking.**	**S1; S3**
2.3	**To Summarize concepts of elucidation of chemical structures leading to logic thinking, followed by evaluation gained information.**	**S1; S3**
2.4	**Demonstrate Oral Communication to carry out Structure Elucidation Sequence orally and mentally, with improving technical writing skills through writing of mini- Reports, with operating electronic mail and Network in communicating with others.**	**S2; S3**
3	**Values:**	
3.1	**Appraise teamwork, decision-making in unpredictable work, and management of resources and time.**	**V1; V2**

C. Course Content

No	List of Topics	Contact Hours
1	**UV/VIS:** Introduction, Theory and instrumentation, Absorption laws, Solvents, Characteristic Absorption of Organic Molecules (Saturated hydrocarbons, Alkenes, Alkynes, Carbonyl compounds, Aromatic Compounds).	**3**
2	**Infrared Spectrometry:** Introduction, short notes about theory and Instrumentation, Interpretation of spectra, Characteristic Absorption of Organic Molecule (Normal Alkanes, branched Alkanes, Cyclic Alkanes, Alkenes, Mononuclear Aromatic Hydrocarbons, Alcohols and Phenols, Ethers, Epoxides and Peroxides, Ketones, Aldehydes, Esters and Lactones, Acid Halides, Amides and Lactams, Carboxylic acids, Amines, Amine Salts, Amino Acids and its Salts, Isonitrile, Organic Sulphur Compounds, Organic Halogen Compounds, Silicon Compounds, Phosphorus Compounds, Hetero aromatic Compounds, Heteroaromatic Compound).	**8**
3	**Proton NMR Spectroscopy:** Introduction, Short notes about Theory and Instrumentation,Chemical Shift, Spin Coupling; Multiples; Spin System, Proton on Oxygen; Nitrogen; Sulphur Atoms, Exchangeable Protons, Simple Introduction for Chemical Shift Equivalence with examples, Magnetic Equivalent (Spin-Coupling Equivalence), AMX, ABX, and ABC Rigid System with Three Coupling Constants, Chirality, Vicinal and Giminal coupling, Low-Range Coupling.	**10**

4	**Carbon ^{13}NMR Spectrometry:**Introduction, Theory (Decoupling Techniques, Chemical Shift Scale and Range, Solvents), Interpretation of simple 13C spectra, Chemical Shift Equivalence, Chemical Classes and Chemical Shifts (Alkanes, Alkenes, Alkynes, Aromatic Compounds, Alcohols, Ethers,Acetals and Epoxides, Halides, Amines, Thiols, Functional Groups Containing Carbon)..	**6**
5	**REVIEW:** includes simple oral presentation by the students for some selected organic compounds with open discussion about strategy to solve the problems	**3**
Total		**30**
Topics to be covered (Laboratories)		

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1.0	**Knowledge and Understanding**		
1.1	**To recognize the basic spectroscopy of organic compounds.**	▪ Two hours are weekly containing lectures ▪ A Private study including home exam.	▪ Quizzes Assignments ▪ Discussions. ▪ Participation.
1.2	**To describe the spectroscopic data of organic compounds by determination the functional group and number of protons and carbons.**	▪ Two hours are weekly containing lectures, and group discussion	▪ Quizzes Assignments. • Oral Discussion marks
1.3	**To interpret the structure of Organic Compounds from spectroscopic data with defining factors influence the chemical structure**	▪ Two hours are weekly for lectures ▪ Think and talk about elucidating of organic compounds spectro-scopically.	• Midterms. • Assignments • Oral Discussions. • Quizzes.
2.0	**Skills:**		
2.1	**To analyze information related to applied organic chemistry.**	▪ Lectures activity ▪ Think and talk about structures and functional groups of organic compounds	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Participation ▪ Oral Discussion, ▪ Home Exam.
2.2	**To interpret data and results through analytical logical thinking.**	▪ Encourage students to communicate their logic chemicalthinking, and to work and discuss cooperatively with their peers to develop individual	• Questions in Lectures. • Participation through Oral Discussion • Short Quizzes and Exams.

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
		skills.	
2.3	**To Summarize concepts of elucidation of chemical structures leading to logic thinking, followed by evaluation gained information.**	▪ Lectures and Oral Discussions. ▪ Brain stormingExercises	▪ Questions in Lectures. ▪ Short Quizzes and Exams.
2.4	**Demonstrate Oral Communication to carry out Structure Elucidation Sequence orally and mentally, with improving technical writing skills through writing of mini- Reports, with operating electronic mail and Network in communicating with others.**	▪ Brain Storms Exercises ▪ Group Discussion	● Oral Discussion. ▪ Group Discussion and Assignments
3.0	**Values**		
3.1	**Appraise teamwork, decision-making in unpredictable work, and management of resources and time.**	• Group discussions and assignments	• Group discussion marks. • Group worksheet assignments.

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Home Exams**	**All the semester**	**20 %**
2	**Midterm Exam 1**	**Around 5th week**	**20 %**
	Midterm Exam 2	**Around 8th week**	**20 %**
4	**Final Exam**	**Around 11th– 12thweek**	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Spectrometric Identification of Organic Compounds***, Robert M. Silverstein; Wiley: New York,7th ed.,2005, ISBN-10: 0471393622.
Essential References Materials	• ***The Systematic Identification of Organic Compounds***; Ralph L. Shriner, Christine K. F. Hermann, Terence C. Morrill, David Y. Curtin, Reynold C. Fuson, Wiley: New York.8th ed. 2004. ISBN-10: 0471215031 • ***Introduction to Spectroscopy***, Donald L. Pavia, Gary M. Lampman, George S. Kriz, James A. Vyvyan., Brooks/Cole, Gerage Learning, 4th Ed., 2009; ISBN-10: 0495114782
Electronic Materials	• **Blackboard** • **http://www.sigmaldrich.com**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The roomsare equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:**Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:**Externalassessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:**Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:**Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:**Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations -

Evaluation Areas/Issues	Evaluators	Evaluation Methods
		Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations-Syllabus review- Accreditation review.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Analytical Chemistry**
Course Code:	**CHM 231**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

A. Table of Contents

B. Course Identification

1. Credit hours:	**4 (3 Lectures, 3 Lab and Tutorial)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 4/Year 2**
4. Pre-requisites for this course (if any)**:**	**General Chemistry 2 – CHM 102**
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**	**60**	**100%**
2	**Blended**		
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**30**
2	**Laboratory/Studio**	**30**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**60**

C. Course Objectives and Learning Outcomes

1. Course Description:

This course is an introduction to the theory, principles, and practices of quantitative analytical chemistry. The course covers the fundamentals of analytical chemistry: statistical data analysis, application of chemical equilibrium to gravimetry, titrimetry and electrochemistry.

2. Course Main Objective: ***This course is intended:***

- To provide a basic knowledge and understanding of essential principles of analytical chemistry.
- To express the concentration of substances in different forms.
- To verify the correctness of the analytical measurements using statistical concepts.
- To introduce the basic analytical techniques and practical aspects of volumetric analysis.
- To solve problems related to titrimetric analysis and interpret analytical results.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	To recognize the main principles of analytical chemistry.	K1
1.2	To state formula related to statistics and the effect of different errors on the analytical results	K2
1.3	To list some of the analytical chemistry methods and types of concentration expressions.	K1, K3
2	Skills :	
2.1	To differentiate between the types of statistical errors and predict results obtained from chemical analysis statistically.	S1, S3
2.2	To conduct accurate chemical analysis through accurate preparation of standards and reagents.	S1, S3
2.3	To manipulate the experimental set-up, Operate different laboratory instruments during laboratory classes and evaluate statistical data to justify analytical measurements. To demonstrate ability to use mail and Network to communicating with others	S4, S3
2.4	To demonstrate oral communication skills by presenting seminars before his class mates and teaching staff, to write reports about real pollution cases in his community and operate electronic mail and Network skills in communicating with others.	S2, S3
3	Values:	
3.1	To Build self-confidence attitudes through single and team work practical sessions, presentations, and discussions. Avoid over consumption of materials and chemicals and keep the lab instruments and equipment clean and safe.	V1, V2

D. Course Content

No	List of Topics	Contact Hours
	Topics to be covered (Lectures and Tutorial)	
1	**Review the basic calculations of analytical chemistry (chemical concentrations and stoichiometry relationship):** Relationship between Analytical Chemistry and other branches of science, General steps in chemical analysis, Measurements , Fundamental SI units , Derived SI units, other units, Conversion to SI units, Prefixes, Chemical concentrations , Molarity , Molality , Percentage composition , ppm and ppb, Preparing Solutions, Dilution, Stoichiometry Calculations.	**2**
2	**Statistics and data analysis in analytical chemistry:** Experimental Errors, Significant Figures, Significant Figures in arithmetic, Addition and Subtraction, Multiplication and Division. Graphs, logarithms and antilogarithms, Types of Errors, Systematic and Random Errors, Precision and Accuracy, Absolute and Relative Uncertainty, Propagation of Uncertainty from random errors	**4**
3	**Acid/Base Titrations: Titration:** methods of end point determination, , acid – base titrations, titration of strong acid with strong base, regions of equivalence point , before , at and after equivalence point, the titration curves, finding the end point with indicators, choosing an indicator. Precipitation Titrations: Precipitation titration curve, concentrations before, at and after the equivalence point, the shape of titration curves.	**2**
4	**Complexometric Titrations:** EDTA titrations, metal chelate complexes, acid-base properties of EDTA, EDTA complexes, EDTA titration curves, regions of equivalence point , before , at and after equivalence point, titration calculations, metal ion indicators, EDTA titrations techniques, direct, indirect , displacement and back titrations, water hardness, masking.	**4**

5	**Oxidation/Reduction Titrations:** Basic concepts of Redox reactions, galvanic cells, salt bridges, line notations, Nernest equation for half reaction, Nernest equation for complete reaction, Redox titrations. The shape of redox titration curves, regions of equivalence point, before, at and after equivalence point, finding the end, Redox indicators.	**6**
6	**Fundamentals of chemical equilibria:** The equilibrium constant. Manipulations of equilibrium constant. Equilibrium and thermodynamics.(enthalpy, entropy and free energy.), Le chatelie principle, solubility products. Common ion effect. Separation by precipitation. Complex formation protic acids and bases, Bronosted concept, salts, conjugate acids and bases. Autoprotysis, pH, strength of acids and bases. Weak acids and bases. Polyprotic acids and bases, relation between Ka and Kb. Solving equilibrium problems with concentration tables.	**6**
7	**Effect of Electrolytes on equilibrium systems:** The effect of ionic strength on the solubility of salts. Meaning of ionic strength, Activity coefficient, pH and the activity coefficients. Systematic treatment of equilibrium. Charge and mass balance. Applications to the systematic treatment of equilibrium. Monocratic acid base equilibrium. strong acids and bases equilibrium. Weak acids and bases , equilibrium. weak acids equilibria + problems. Weak bases equilibria + problems. Buffers. Henderson – Hassel Balch Equation. Buffer action. Addition of acids and bases to buffers. How to prepare a buffer solution. poly protic acid base equilibrium, diprotic acids and bases equilibrium + calculations poly protic acid base equilibrium, triprotic systems identification of principle species in the equilibrium	**6**
Topics to be covered (Laboratories)		
1	Safety in the Chemistry Laboratory & Laboratory Report writing & (1)Assuring the Quality of Weight Measurements (Calibration of the Analytical Balances). (2) Statistical Evaluation of Measurements.	**3**
2	(1) Weight Uniformity of Dosing Units (2) Statistical Evaluation of Measurements.	**3**
3	Determination of the Acidic Content of Vinegar	**3**
4	(1) Calibration of PH-meter. (2) PH Titration Curves of Weak Acid and bases).	**3**
5	(1) Preparation and Standardization of EDTA. (2)Determination of Water Hardness	**3**
6	(1) Standardization of Silver Nitrate Solution. (2) Determination of Chloride Content in Table Salt and Tap Water by the Mohr Method	**3**
7	Standardization of Ferrous Ammonium Sulphate Using Standard Potassium Dichromate Solution. & Determination of Iron Oxide Content in Portland Cement.	**3**
8	(1) Sampling of Natural Samples, e.g., Soil of the garden, Rocks, Plant Leaves, etc. (2) Sampling of Commercial Products, eg, Cement, Flour, Toilet Soap.	**3**
9	Determination of Moisture Content in Natural and Industrial Samples & Practice of Gravimetric Analysis Using Physical Separation Methods: Gravimetric Determination of Sulphate in a Commercial Unknown.(gypsum).	**3**
10	The Percent of Water of Crystallization in Hydrated Barium Chloride.	**3**
Total		**60**

E. 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**		
1.1	To recognize the main principles of analytical chemistry.	lecturing	Short quizzes
1.2	To state formula related to statistics and the effect of different errors on the analytical results	Lecturing, solving problems, group discussions, Homework and assignment	Homework and assignment marks and written exams
1.3	To list some of the analytical chemistry methods and types of concentration expressions.	Discussions, Laboratory classes	Quizzes and MCQs, laboratory reports
2.0	**Skills**		
2.1	To differentiate between the types of statistical errors and predict results obtained from chemical analysis statistically.	Lecturing, oral discussion and laboratory experiments	Short quizzes Exams, Homework assignment and laboratory reports
2.2	To conduct accurate chemical analysis through accurate preparation of standards and reagents.	Lecturing and oral discussion supported by laboratory experiments	Homework assignment, Examination and laboratory report
2.3	To manipulate the experimental set-up, Operate different laboratory instruments during laboratory classes and evaluate statistical data to justify analytical measurements. To demonstrate ability to use mail and Network to communicating with others	• Provide student with manual and instructions. • Group discussions and virtual labs. • Use network and computer's software Use blackboard to submit homework	• Laboratory performance evaluation • Laboratory reports and sheet • Oral tests and assignments marks Assignments and homework
2.4	To demonstrate oral communication skills by presenting seminars before his class mates and teaching staff, to write reports about real pollution cases in his community and operate electronic mail and Network skills in communicating with others.	• Oral participation • Group discussions and lab experiment and reports • Encourage students to use electronic mail to submit homework and assignments.	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks
3.0	**Values**		
3.1	To Build self-confidence attitudes through single and team work practical sessions, presentations, and discussions. Avoid over consumption of materials and chemicals and keep the lab instruments and equipment clean and safe.	• Group discussion, assignments and homework • Lab-reports • Virtual labs and demonstrations	• Oral tests, lab performance, Lab-reports and sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Homework**	**All the semester**	**10 %**

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Quizzes, Attendance, Participation, Homework	All the semester	10%
2	Laboratory	All the semester	30 %
3	Midterm Exam 1	Around 5th week	10 %
4	Midterm Exam 2	Around 8th week	10%
5	Final Exam	Around 11th– 12thweek	40 %
6	Total		100%

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

F. Student Academic Counseling and Support

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

- **There are two office hours per week reserved by each staff member, planned on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counselling.**

G. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	• ***Quantitative Chemical Analysis***, Daniel C. Harris, 8th edition,2010, W. H. Freeman & Co., New York, ISBN: 9781429218153.
Essential References Materials	• ***Modern Analytical Chemistry***, David Harvey, , 1st Ed., 2000, McGraw-Hill, ISBN: 0–07–237547–7 • ***Chemical Analysis: Modern Instrumentation Methods and Techniques,*** Francis Rouessac, Annick Rouessac, , 2nd Ed, 2007, John Wiley & Sons, ISBN: 0470859040, 9780470859049. • ***Principles of Instrumental Analysis***", D. A. Skoog, F. J. Holler, S.R. Crouch,; 6th edition (2006) , Brooks Cole, ISBN: 0495012017 , 978-0495012016.
Electronic Materials	• **Blackboard** • **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true** • **http://www.chem1.com/acad/webtext/virtualtextbook.html** • **http://www.shodor.org/UNChem/index.html**
Other Learning Materials	**Internal server: www. Elesevier.com**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

H. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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)

I. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Physical Chemistry (1)**
Course Code:	**CHM 241**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 4 (2 Lectures, 2 Lab, 2Tutorials)	
2. Course type	
a. University ☐ College ☐ Department ☑ Others ☐	
b. Required ☑ Elective ☐	
3. Level/year at which this course is offered: Level 3 / Year 1	
4. Pre-requisites for this course: General Chemistry (2) CHM 102	
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	60	100 %
2	Blended		0
3	E-learning		0
4	Distance learning		0
5	Other		0

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	20
2	Laboratory/Studio	20
3	Tutorial	20
4	Others (specify)	0
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

Topics covered in the course include the properties of ideal gas and some laws related to them and the real gas properties. First, second and third laws of thermodynamics, the equilibrium states, Application of the Gibbs function and the Planck function to some phase changes.

2. Course Main Objective

At the end of the course, Students should be able:

- ***To define the concept of standard state and thermodynamic functions of pure substances due to change of temperature.***
- ***To list the thermodynamic concept of phase equilibrium, chemical equilibrium, entropy, and Gibb's free energy.***
- ***To estimate the heat of reaction from tabulated bond energy values.***

- ***To evaluate the elevation in boiling point and depression in freezing point of solutions due to salt addition.***
- ***To analyze data and results through analytical thinking, with evaluation of the gained information.***
- ***To diagram and illustrate experimentally obtained data.***

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To define the concept of standard state and thermodynamic functions of pure substances due to change of temperature and state main gas laws and their applications.**	**K1; K2; K3**
1.2	**To describe the change of vapour pressure of pure liquids and solids due to change in temperature**	**K1**
1.3	**To list the thermodynamic concept of phase equilibrium, chemical equilibrium, entropy, and Gibb's free energy.**	**K1; K3**
2	**Skills :**	
2.1	**To estimate the heat of reaction from tabulated bond energy values and evaluate the elevation in boiling point and depression in freezing point of solutions due to salt addition**	**S1; S2; S3**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S2; S3**
2.3	**To demonstrate skills to participate in class by asking questions and giving answers.**	**S3**
2.4	**To diagram and explain experimental data during laboratory classes, demonstrate technical writing and oral communication skills, and operate electronic mail and network in communication with classmates and teachers.**	**S4; S3**
3	**Values:**	
3.1	**To appraise coordination in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.**	**V1;V2**

C. Course Content

No	List of Topics	Contact Hours
1	• Nature of physical chemistry. Classical mechanics and Properties of Gases, The Perfect Gas – States of gases • Gas laws, Individual Gases, Boyle's Law, Charles's and Gay-Lussac's law, Avogadro's Principle, Graham's law, Perfect (Ideal) Gas Equation, Mixtures of Gases. • Dalton's Law, Mole Fractions, Real Gases, Virial coefficients, Molecular Interactions, Compression factor Boyle's Temperature, CO2 Phase Diagram, Condensation. • Critical Constants, van der Waals Equations, Principle of Corresponding States, Kinetic Model of Gases.	**8**
2	• Introduction to Thermodynamics, Basic Concepts (Work, Heat and Energy), ZEROth Law. The First Law of Thermodynamics - Conservation of Energy, Systems and Surroundings.	**8**

	• Expansion Work, General Expression for Work, Free Expansion, Expansion Against Constant Pressure, Reversible Expansion, Isothermal Reversible Expansion, Heat Transactions, Calorimetry, Heat Capacity. • Enthalpy, Definition of Enthalpy, Measurement of Enthalpy, Variation of Enthalpy with Temperature, Relation Between Heat Capacities, Adiabatic Change, Work of Adiabatic Change, Heat Capacity and Adiabats. • Standard Enthalpy Changes, Enthalpies of Physical Change, Enthalpies of Chemical Change, Hess' Law, Standard Enthalpies of Formation Changes, Reaction Enthalpy & Enthalpy of Formation, Group Contributions, Temperature Dependence of Reaction Enthalpies.	
3	• State Functions, Exact and inexact differentials, • Changes in internal energy, The Joule experiment, Changes in internal energy at constant p. • Temperature Dependence of Enthalpy, Changes in enthalpy at constant volume, Isothermal compressibility, Joule-Thomson effect, CV vs. Cp.	**8**
4	• The second law of thermodynamics. Carnot Cycle and entropy: The Concepts, Direction of Spontaneous Change, Dispersal of Energy, Entropy, Thermodynamic definition, Entropy as a State Function, The Clausius Inequality. • Entropy of Phase Transition at the Transition Temperature, Expansion of the Perfect Gas, Variation of Entropy with Temperature, Measurement of Entropy. • Third Law of Thermodynamics, Nernst Heat Theorem, Third-Law Entropies, Reaching Very Low Temperatures, Helmholtz and Gibbs Energies, Helmholtz Energy, Maximum Work, Gibbs Energy, Maximum Non-Expansion Work, Standard Molar Gibbs Energies.	**11**
5	• Simple Mixtures, Thermodynamic Description of Mixtures, Partial Molar Quantities, Partial Molar Volume, Partial Molar Gibbs Energies, Significance of Chemical Potential, Gibbs-Duhem Equation, • Thermodynamics of Mixing, Gibbs Energy of Mixing, Other Thermodynamic Mixing Functions, Chemical Potentials of Liquids, Ideal Solutions, Ideal Dilute Solutions. • The Properties of Solutions, Liquid Mixtures, Colligative Properties, Boiling point elevation, Freezing point depression, Solubility, osmotic Pressure, Activities, Solvent Activity, Solute Activity, Regular Solutions.	**5**
Total		**40**
Topics to be covered (Laboratories)		
Lab 01	Safety and Laboratory equipment and measurements and reports Boyle and Mariette's law (P, V), Amontons' law (P,T)	**2**
Lab 02	Gay-Lussac's law (V, T), Avogadro' s law (V, n)	**2**
Lab 03	•Determination of heat of solution from solubility Thermal equation of state and critical point	**2**

Lab 04	•Calibration of a calorimeter and Determination of the specific heat capacity of an Unknown Metal	**2**
Lab 5	•Determination of the calorific value for heating oil and the gross calorific value for olive oil	**2**
Lab 6	•Determination of the heat of formation for water	**2**
Lab 7	•Determination of the enthalpy of vaporization of liquids	**2**
Lab 8	•Enthalpy of Reaction - Hess's Law •Equilibrium and Le Châtelier's Principle	**2**
Lab 9	•Part I: Determination of the Effect of Various Influences on the Position of Equilibrium	**2**
Lab 10	•Part II: Determination of the Effect of Various Influences on the Position of Equilibrium Review	**2**
Total		**20**

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**		
1.1	**To define the concept of standard state and thermodynamic functions of pure substances due to change of temperature and state main gas laws and their applications.**	**Lectures**	**Short quizzes and exams**
1.2	**To describe the change of vapour pressure of pure liquids and solids due to change in temperature**	**Lectures and tutorials**	**MCQs and quizzes**
1.3	**To list the thermodynamic concept of phase equilibrium, chemical equilibrium, entropy, and Gibb's free energy.**	**Numerical examples and laboratory experiments**	**Laboratory reports Numerical problem solution grades**
2.0	**Skills**		
2.1	**To estimate the heat of reaction from tabulated bond energy values and evaluate the elevation in boiling point and depression in freezing point of solutions due to salt addition**	**Tutorials** **Lectures and laboratory experiments**	**Solved problem marks** **Short quizzes and Laboratory reports** **Numerical problem**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**Tutorial, Brain storming and self-study**	**Work portfolio and homework**
2.3	**To demonstrate skills to participate in class by asking questions and giving answers.**	**Motivate students to ask questions and to give response.**	**Participation marks**

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.4	To diagram and explain experimental data during laboratory classes, demonstrate technical writing and oral communication skills, and operate electronic mail and network in communication with classmates and teachers.	• Oral participation • Group discussions and lab experiment and reports • Encourage students to use electronic mail to submit homework and assignments.	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks
3.0	**Values**		
3.1	To appraise coordination in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.	• Group discussion and assignments • homework • Lab-reports • Virtual labs and demonstrations	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	10 %
2	Midterm 2	8th/9th weak	10%
3	Quizzes, Home Works, class participation, and mini projects	During the semester	10 %
4	Laboratory	All the semester	30 %
5	Final Exam	11th/ 12th week	40 %
6	Total	All weeks	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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**

- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• **Physical Chemistry,** K. J. Laidler, J. H. Meiser, B. C. Sanctuary, 4th Ed, 2003,Houghton Mifflin Company [ISBN: 0618123415] • **Advanced Physical Chemistry Experiments,** J. N Gurtu, Amit Gurtu (2008) Meerut, India, Pragati Prakashan, ISBN:978-81-8398-527-7
Essential References Materials	• **Physical Chemistry,** P.W Atkins, and J. de Paula 8th Ed. 2001, New York, NY: W.H. Freeman and Company, (ISBN: 9780716735397 • **Physical Chemistry,** R.Silbey, R. Alberty, and M. Bawendi. 4th ed. 2004, New York, NY: John Wiley & Sons, ISBN: 9780471215042.
Electronic Materials	• **Blackboard** **www. Elesevier.com**
Other Learning Materials	• **An Introduction for Students of Physical Chemistry, Atoms and Molecules: Karplus, M., and R. Porter. Reading, MA: Addison Wesley, 1970 (ISBN: 9780805352184).**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each classroom is equipped with PC and retro projector with a maximum of 30 students.** • **Each Laboratory should be equipped with maximum 25 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio.

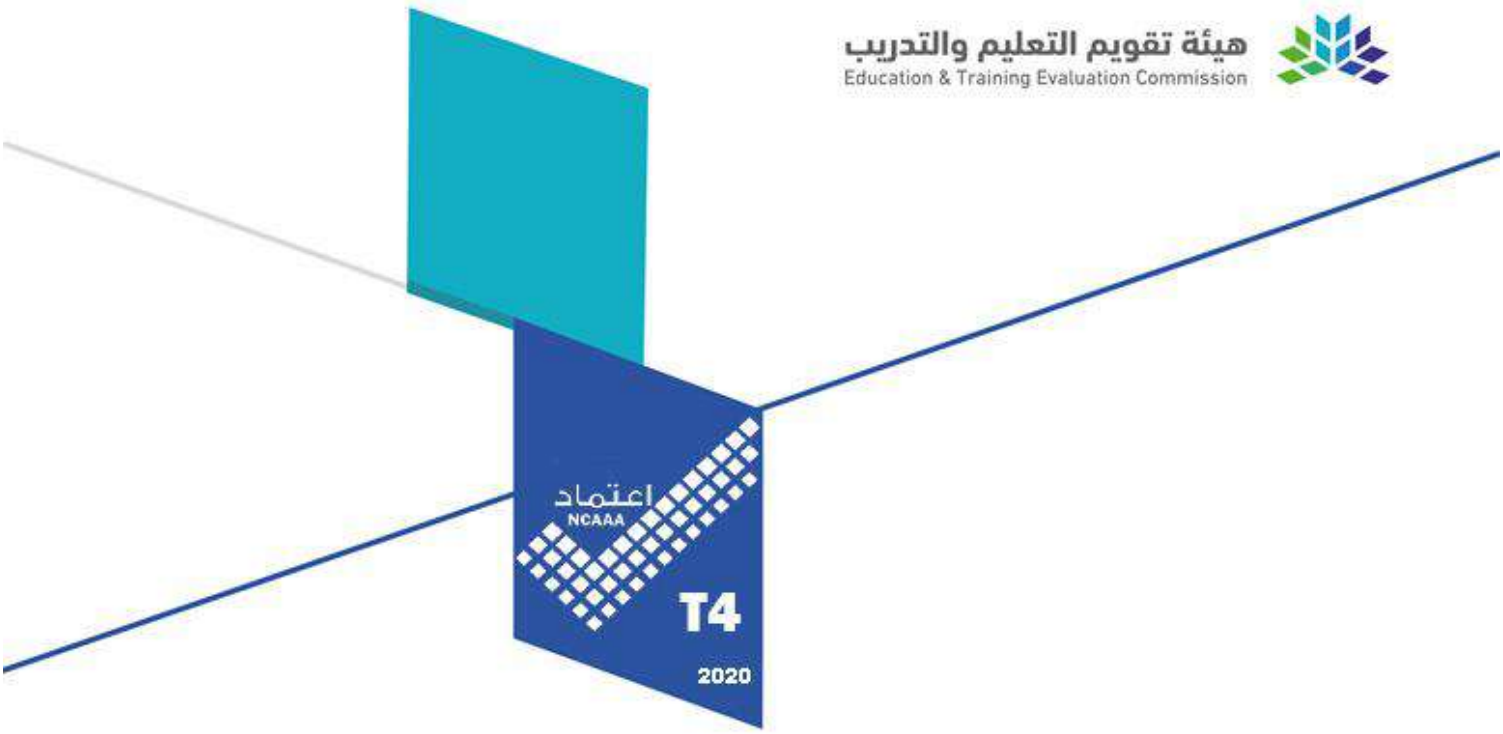
Evaluation Areas/Issues	Evaluators	Evaluation Methods
		Indirect: Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Physical Chemistry (2)**
Course Code:	**CHM 242**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 4 (3 Lectures, 3 Lab and Tutorials)
2. Course type **a.** University ☐ College ☐ Department ✓ Others ☐ **b.** Required ✓ Elective ☐
3. Level/year at which this course is offered: Level 4 / Year 2
4. Pre-requisites for this course: Physical Chemistry (1) –CHM 241
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	60	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	30
2	Laboratory/Studio and Tutorial	30
4	Others (specify)	
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

Topics covered in the course include the description of the laws of phase transformations of pure substances followed by applications. Derivation and applications of phase rules on Two-Component Systems, vapor Pressure Diagrams. The Lever Rule. Temperature-Composition Diagrams. Distillation of Mixtures, Azeotropes, Immiscible Liquids. Distillation of Partially Miscible Liquids, Liquid-Solid Phase Diagrams, Eutectics. Chemical Equilibrium, The Description of Equilibrium, Perfect gas equilibria,The Response of Chemical Equilibria to Conditions, Quantitative chemical kinetics, Kinetics of complex multistep reactions.

2. Course Main Objective

At the end of the course, Students should be able to:

- ***recall phase transformations laws***
- ***describe the basic principles of chemical equilibria related to thermodynamic functions***

- *state the laws of colligative properties*
- *evaluate the equilibrium constant from experimental data.*
- *interpret the equilibrium state or direction on variation operational conditions.*
- *determine reaction rate laws and constants along with the factor effecting them.*
- *operate laboratory instruments.*
- *diagram and illustrate experimentally obtained data.*

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recall phase transformations laws**	**K1; K2; K3;**
1.2	**To describe the basic principles of chemical equilibria related to thermodynamic functions**	**K1; K2; K3;**
1.3	**To state the factors affecting reaction rate and the laws of chemical kinetics**	**K1; K3**
2	**Skills :**	
2.1	**To evaluate the equilibrium constant from experimental data, and contrast kinetic data with Mathematical equations.**	**S1; S2; S3**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S2; S3**
2.3	**To demonstrate skills to participate in class by asking questions and giving answers.**	**S3**
2.4	**To diagram and illustrate experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	**S2; S4**
3	**Values:**	
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	**V1;V2**

C. Course Content

No	List of Topics	Contact Hours
1	• Physical Transformations of Pure Substances, Phase Diagrams, Stabilities of Phases, Phase Boundaries, Three Typical Phase Diagrams, Phase Stability and Phase Transitions, • Thermodynamic Criterion of Equilibrium, Dependence of Stability on the Conditions, Location of Phase Boundaries, Ehrenfest Classification of Phase Transitions • Phase Transitions, Ehrenfest Classification of Phase Transitions. • Physical Liquid Surface, Surface Tension. • Curved Surfaces, Bubbles, cavities and droplets, Nucleation, and • Capillary Action	**8**
2	• Phase Transformations: Phases, Components and Degrees of Freedom, Definitions. • The Phase Rule, Two-Component Systems, Vapor Pressure Diagrams, Composition of the Vapor, Interpretation of the Diagrams. • The Lever Rule. Temperature-Composition Diagrams. • Distillation of Mixtures, Azeotropes, Immiscible Liquids	**10**

	• Liquid-Liquid Phase Diagrams, Phase Separations, Critical Solution Temperatures, Distillation of Partially Miscible Liquids, Liquid-Solid Phase Diagrams, Eutectics.	
3	• Chemical Equilibrium: Spontaneous Chemical Reactions, The Gibbs Energy Minimum, The reaction Gibbs energy, Exergonic and endergonic reactions. • The Description of Equilibrium, Perfect gas equilibria. The general case of a reaction, the relation between equilibrium constants, molality and mole fractions, The Boltzmann Distribution. Responses of Chemical Equilibria. • The Response of Chemical Equilibria to Conditions, the Response to Pressure. The Response to Temperature, • The Response to pH. Revision on the Response of Chemical Equilibria to Conditions. Acid-base equilibria in water and Buffer solutions.	**6**
4	• Quantitative chemical kinetics • Integration of rate equations, zero, first, second order cases, rate constant. • Graphical analysis of rate data for rate constant and half-life determination for each case. Dependence of rate on temperature. • Arrhenius equation and activation energy, • Kinetics of complex multistep reactions. Consecutive reactions. • Concept of rate determining step and reaction intermediate. Surface reactions involving adsorbed reactants (Langmuir and Freundlich adsorption isotherm).	**6**
Total		**30**

Topics to be covered (Laboratories)		
Lab 01	Safety and Laboratory equipment's and measurements and reports	**3**
Lab 02	Mutual Solubility Curve for Phenol – Water system	**3**
Lab 03	The Melting point of a binary system (Eutectic point)	**3**
Lab 04	Phase diagram for a three-component system	**3**
Lab 05	Partial Molar Properties of Solutions	**3**
Lab 06	Determination of the distribution coefficient of the acetic acid between water and Diethyl ether	**3**
Lab 07	Determination the equilibrium constant of the reaction KI + I_2 = KI_3 by distribution method	**3**
Lab 08	Chemical Kinetics (The Iodine Clock Reaction)	**3**
Lab 09	Kinetics of first order reactions (Hydrolysis of ethyl acetate in acidic solution)	**3**
Lab 10	Catalysts for the decomposition of hydrogen peroxide	**3**
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 and Understanding**		
1.1	**To recall phase transformations laws**	**Lecture**	**Short quizzes**
1.2	**To describe the basic principles of chemical equilibria related to thermodynamic functions**	**Lecture and laboratory experiments**	**Exams and lab reports**

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.3	To state the factors affecting reaction rate and the laws of chemical kinetics	Lecture, homework, Group discussions and laboratory experiments	Homework assignment marks, Oral test and lab reports
2.0	**Skills**		
2.1	To evaluate the equilibrium constant from experimental data, and contrast kinetic data with Mathematical equations.	Tutorials Lectures and laboratory experiments	Solved problem marks Short quizzes and Laboratory reports Numerical problem
2.2	To analyze data and results through analytical thinking, with evaluation of the gained information.	Tutorial, Brain storming and self-study	Work portfolio and homework
2.3	To demonstrate skills to participate in class by asking questions and giving answers.	Motivate students to ask questions and to give response.	Participation marks
2.4	To diagram and illustrate experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.	• Seminars • Group discussions and lab experiment • Encourage students to use electronic mailand blackboard to submit works and assessments.	• Presentation marks • Oral tests and lab sheets • Assignments and homework • Laboratory performance • Laboratory reports and sheet
3.0	**Values**		
3.1	To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.	• Group discussions • Homework • Mini reports • Virtual labs and demonstrations	• Presentation marks • Oral tests Assessments and homework • Laboratory reports and sheet

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	10 %
2	Midterm 2	8th/9th weak	10%
3	Quizzes, Home Works, class participation, and mini projects	During the semester	10 %

#	Assessment task*	Week Due	Percentage of Total Assessment Score
4	Laboratory	All the semester	30 %
5	Final Exam	10-11thweek	40 %
6	Total	All weeks	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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Physical Chemistry***, K. J. Laidler, J. H. Meiser, B. C. Sanctuary, 4th Ed, 2003,Houghton Mifflin Company [ISBN: 0618123415.
Essential References Materials	• ***Physical Chemistry***, Atkins, P., and J. de Paula. 8th ed. New York, NY: W.H. Freeman and Company, 2001 (ISBN: 9780716735397 1. ***Physical Chemistry,*** Silbey, R., R. Alberty, and M. Bawendi. 4th Ed, 2004. New York, NY: John Wiley & Sons, ISBN: 9780471215042.
Electronic Materials	• **Blackboard** • **www. Elesevier.com**
Other Learning Materials	**An Introduction for Students of Physical Chemistry**. Reading, MA: Addison Wesley, 1970 (ISBN: 9780805352184)

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each classroom is equipped with PC and retro projector with a maximum of 25 students.** • **Each Laboratory should be equipped with maximum 25 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

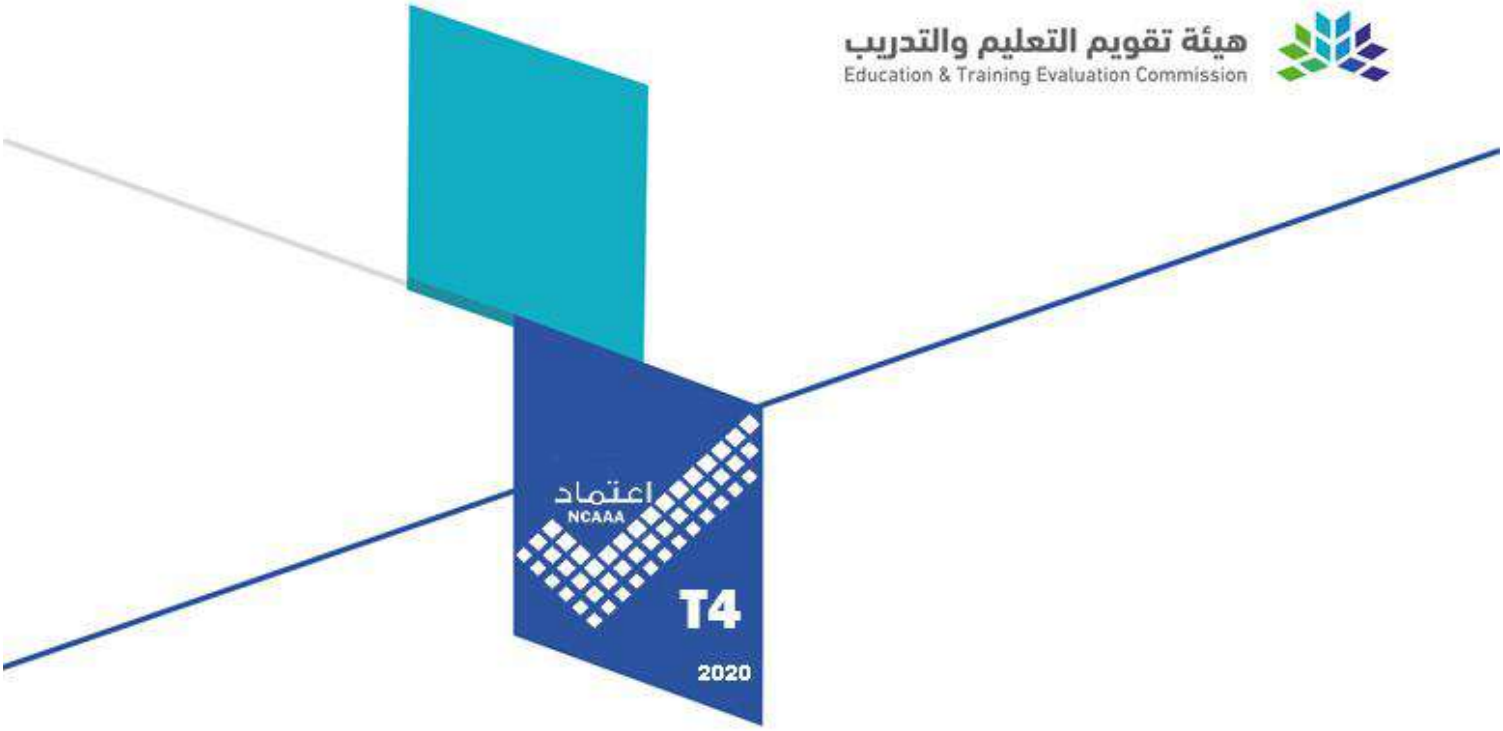
Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Software in chemistry**
Course Code:	**CHM 251**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**2 (0 Lectures, 4 Lab, 0 Tutorials)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 3 / Year 1**
4. Pre-requisites for this course (if any)**:**	**General Chemistry (1)- CHM 101**
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**	**40**	**100%**
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**0**
2	**Laboratory/Studio**	**40**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**40**

B. Course Objectives and Learning Outcomes

1. Course Description

The course covers the all required knowledge and information for appropriate software that will be apply in his labs and courses. The course will provide sufficient information and application to do search and download scientific papers and books.

2. Course Main Objective

At the end of this course the student will be able to:

- Use the computer software such as Excel to present his data graphically and obtain constants.
- Download lectures, refrences, books and research articles that .
- Wtite his home work, mini-projects and graduation project using Microsoft Word.

3. Course Learning Outcomes

	CLOs	AlignedPLOs
1	**Knowledge and Understanding**	
1.1	**To recognize the importance of software chemistry**	**K1; K2; S1**
1.2	**To list of applications of software chemistry**	**K1; K2; S1**
1.3	**To search in scientific journals and database.**	**K1; K2; S1**
2	**Skills:**	
2.1	**To write a simple mechanism using appropriate software program**	**K1; K3; S1; S2**
2.2	**To compare between the software programs**	**S1; S2; S3**
2.3	**Operate Computer, software in, Perform Calculations, and chemical drawing.**	**K1; S2**
3	**Values:**	
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	**V1; V2**

C. Course Content

No	List of Topics	Contact Hours
1	The Evolution of Computers in Chemistry Computing and Communications in Chemistry Education	**2**
2	**Microsoft Word:** format copy, page layout: margins, orientation, size, columns, breaks: pages, columns, text wrapping, next page, continuous, even and odd pages, line numbers, review: track changes, show comments, accept and reject, insert: cover pages, pictures, tables, shapes, charts, hyperlink, bookmark, comment, header, footer, page number, text box, word art, symbol, object, design: themes, colors, fonts, watermark, page color, page borders, references: table of contents, insert footnote, insert endnote, insert citation, view: read mode, print layout, web layout, outline, draft, ruler, gridlines, navigation pane, zoom, one page, multiple pages, page width, table design: header row, total row, first column, last column, plain tables, grid tables, styles, shading, borders styles, layout: select, view grids, draw table, erase, delete, insert (above, below, left, right), split (cells, tables), auto fit, alignment, sort, convert to text, pictures properties, word to pdf	**5**
3	**Microsoft Excel: home:** clipboard, font, alignment, number, styles, cells, editing, insert: tables, illustrations, charts, hyperlinks, text, symbol, page layout: themes, page setup, scat to fit, sheet options, arrange, formulas: function library, data: data tools, outline, review: proofing, language, comments, changes, view: workbook view, show, zoom, windows.	**7**
4	**Libreoffice :** format copy, page layout: margins, orientation, size, columns, breaks: pages, columns, text wrapping, next page, continuous, even and odd pages, line numbers, review: track changes, show comments, accept and reject, insert: cover pages, pictures, tables, shapes, charts, hyperlink, bookmark, comment, header, footer, page number, text box, word art, symbol, object, design: themes, colors, fonts, watermark, page color, page borders, references: table of contents, insert footnote, insert endnote, insert citation, view: read mode, print layout, web layout, outline, draft, ruler, gridlines, navigation pane, zoom, one page, multiple pages, page width, table design: header row, total row, first column, last column, plain tables, grid	**6**

	tables, styles, shading, borders styles, layout: select, view grids, draw table, erase, delete, insert (above, below, left, right), split (cells, tables), auto fit, alignment, sort, convert to text, pictures properties, word to pdf	
5	**ChemOffice:** Chemical Drawing Software	**6**
6	**ChemScetch:** Chemical Drawing Software,	**6**
7	**Bibliographic Databases** using Endnote, Mendeley, Chemical Abstracts, Journals, Conferences, Reports, Patents	**4**
8	**Chemistry link collections:** Major chemistry resources, Specialist resources, chemistry web search sites, ... etc.	**4**
Total		**40**

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1.0	**Knowledge and Understanding**		
1.1	**To recognize the importance of software chemistry**	• Four hours are weekly containing Laboratory activities and Oral Discussion. • A Private study including work on writing report.	• Laboratory Reports. • Oral Discussion marks • Participation.
1.2	**To list of applications of software chemistry**	• Four hours are weekly containing Laboratory activities with group discussion. • Think and discuss about Required Software chemistry	• Lab. Reports. • Oral Discussions.
1.3	**To search in scientific journals and database.**	• Four hours are weekly containing Laboratory activities with group discussion. • Think and write about the chemical equation by appropriate software	• Laboratory Reports • Oral Discussions.
2.0	**Skills**		
2.1	**To write a simple mechanism using appropriate software program**	• Laboratory activities • Think and write about the chemical equation by appropriate software	• Questions in labs. • Participation through Laboratories • Oral Discussion,

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
2.2	**To compare between the software programs**	• Encourage students to communicate their logic chemical thinking, and to work and discuss cooperatively with their peers to develop individual skills.	• Questions in labs. • Participation through Laboratories • Oral discussion
2.3	**Operate Computer and software in and Perform Calculaions and chemical drawing.**	• Encourage the students to use the Chemicals Glass wares and Instruments with caring and safety	• Oral Discussion. • Discussion marks • Giving marks for participation in the lab.
3.0	**Values**		
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	• labs and Group discussion • Have the ability to ask and answer questions as they arise • Brain storming Exercises	• Questions in labs. • Participation through Laboratories • Oral discussion.

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Lab. Reports**	**All the semester**	**20 %**
2	**Midterm Exam 1**	**Around 5th week**	**20 %**
3	**Midterm Exam 2**	**Around 8th week**	**20 %**
3	**Final Exam**	**Around 11th– 12th week**	**40 %**
4	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	▪ **Computer Software Applications in Chemistry, Peter C. Jurs, 2nd Edition. ISBN: 978-0-471-10587-9**
Essential References Materials	
Electronic Materials	• **Blackboard** • **http://www.acdlabs**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each Laboratory should be equipped with maximum 20 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**ORGANOMETALLIC CHEMISTRY**
Course Code:	**CHM 313**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

A. Table of Contents

B. Course Identification

1. Credit hours: 4(4 Lectures, 0 Lab, 0 Tutorial)
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: Level 6/Year 2
4. Pre-requisites for this course (if any)**:** Inorganic Chemistry 2 – CHM 212
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	40	100%
2	Blended		
3	E-learning		
4	Correspondence		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	40
2	Laboratory/Studio	0
3	Tutorial	0
4	Others (specify)	0
	Total	40

C. Course Objectives and Learning Outcomes

1. Course Description:

This course provides students with an introduction to Organometallic Chemistry, definitions, historical developments, Coordination theories, and also the 18-electron rule. The course will cover the Organometallics of Group.1 and Group.2, as well the transition metals. The Organometallic reactions and catalysis, and its application will be included.

2. Course Main Objective: ***This course is intended:***

- ***To improve the student's knowledge of the basic information about Organometallic Chemistry.***
- ***To outline Organometallic Reactions and Catalysis,***
- ***To recall the applications of organometallic compounds (catalytic processes, organic synthesis, therapeutics, biocides, qualitative and quantitative analysis, metallurgical operations and polymers).***

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To describe the basic concepts of organometallic chemistry, and its nomenclature and to recall the concept of effective atomic number and molecular orbital diagrams of organometallic compounds,**	**K1; K2**
1.2	**To outline the bonding and bridging modes for organic ligands structure**	**K1**
1.3	**To recognize synthetic methods of organometallic compounds with different applications in catalytic processes.**	**K1; K2**
2	Skills :	
2.1	**To differentiate between Organometallic Compounds and to explain the relationship among organic ligands structure for use in Organometallic Chemistry.**	**S1; S2; S3**
2.2	**To design routes for Organometallic Compounds synthesis.**	**K2; S1; S2; S3**
2.3	**To analyze spectral data of organometallic compounds and to explain the reactivity of Organometallic Compounds as a catalyst.**	**K2; S1; S2; S3**
2.4	**To demonstrate oral and network communication and technical writing skills.**	**S2; S3**
3	Values:	
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	**V1, V2**

D. Course Content

No	List of Topics	Contact Hours
	Topics to be covered (Lectures and Tutorial)	
1	**Introduction**: Definition of organometallic compounds, Organic ligands and nomenclature Historical developments, types of organometallic compounds, preparation of organometallic compounds, Grignard Reagents, Properties of organometallic compounds.	**8**
2	**Coordination Theories**: Valence Bond Theory, Limitations of Valence Bond Theory, Ligand Field Theory, ligand field splitting, Octahedral Fields, Tetrahedral, Tetragonal, and Square Planar Fields, tetragonal distortion, Factors Affecting Δ, Ligand Field Stabilization Energy, Jahn-Teller Distortion, Limitations of Crystal Field Theory, Molecular Orbital Theory	**3**
3	**The 18-electron rule**, Exceptions to 18-electron rule, Hapticity, Metallocenes	**5**
4	**Bonding between Metal atoms and Organic π Systems**, Linear systems, π-Ethylene complexes, π-Allyl complexes, other linear π systems, cyclic π Systems, cyclopentadienyl (Cp) complexes, Ferrocene, (η5 -C5H5)2Fe, complexes containing cyclopentadienyl and CO ligands.	**5**
5	**Organometallics of Group 1 and 2**: preparations, reactions and applications, Organoelement Compounds of the Carbon Group (Group 14) (preparations, reactions and applications), Organometallics of group 12 (preparations, reactions and applications)	8
6	**Organometallic Reactions and Catalysis**: Reactions involving gain or loss of ligands, Ligand dissociation and substitution, Oxidative addition, Reductive elimination, Nucleophilic displacement, Reactions involving modification of ligands, Insertion, Carbonyl insertion (alkyl migration, Hydride elimination, Abstraction, Cyclometallations, Nucleophilic Displacement, Catalytic Deuteration, Hydroformylation, Monsanto Acetic Acid Process, Wacker (Smidt) Process, Hydrogenation (Wilkinson's catalyst), Olefin Metathesis.	**7**

7	**Applications of Organometallics**: Zieglear- Natta catalysis and Wilkinson catalysis, Organic synthesis, Therapeutics, Biocides, Qualitative analysis, Quantitative analysis, Metallurgical operations, Polymers.	**2**
8	**Revisions.**	**2**
Total		**40**

E. 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**		
1.1	**To describe the basic concepts of organometallic chemistry, and its nomenclature and to recall the concept of effective atomic number and molecular orbital diagrams of organometallic compounds,**	lecturing	Short quizzes
1.2	**To outline the bonding and bridging modes for organic ligands structure**	Lecturing, group discussions, Homework and assignment	Oral test, Homework and assignment marks and written exams
1.3	**To recognize synthetic methods of organometallic compounds with different applications in catalytic processes.**	Tutorials	Participation, Quizzes and MCQs,
2.0	**Skills**		
2.1	**To differentiate between Organometallic Compounds and to explain the relationship among organic ligands structure for use in Organometallic Chemistry.**	● Lectures activity ● Think and talk about the reactivity of Organometallic Compounds ● Introduce some solved and unsolved examples of Organometallic Compounds Synthesis and Reactivity achieving	● Questions in Lectures. ● Short Quizzes and Exams. ● Participation through Class work and Homework.
2.2	**To design routes for Organometallic Compounds synthesis.**	Encourage students to communicate their logic chemical thinking, and to work and discuss cooperatively with their peers to develop individual skills.	● Questions in Lectures. ● Short Quizzes and Exams.
2.3	**To analyze spectral data of organometallic compounds and to explain the reactivity of Organometallic Compounds as a catalyst.**	● Lectures and Group discussion Have the ability to ask and answer questions as they arise	● Questions in Lectures. ● Short Quizzes and Exams. ● Oral Presentation

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.4	**To demonstrate oral and network communication and technical writing skills.**	• Oral participation • Group discussions • Encourage students to use electronic mail to submit homework and assignments.	• Oral tests and sheets Marks • Assignments and homework marks
3.0	**Values**		
3.1	To Build self-confidence attitudes through single and team work practical sessions, presentations, and discussions. Avoid over consumption of materials and chemicals and keep the lab instruments and equipment clean and safe.	Group discussion, assignments and homework	• Oral tests, sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Homework**	**All the semester**	**20 %**
2	**Midterm Exam 1**	**Around 5th week**	**20%**
3	**Midterm Exam 2**	**Around 8th week**	**20%**
4	**Final Exam**	**Around 11th– 12thweek**	**40 %**
5	**Total**		**100%**

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

F. Student Academic Counseling and Support

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

- **There are two office hours per week reserved by each staff member, planned on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counselling.**

G. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	• ***Organometallic Chemistry***, G. S. Sodhi, 2009, Ane Books Pvt. Ltd. ISBN: 8180521982
Essential References Materials	• ***Inorganic Chemistry, Catherine E. Housecroft and Alan G. Sharpe, 2nd Ed. 2005, Publisher: Pearson Education Limited, ISBN 0130-39913-2.*** • ***Inorganic Chemistry, Gary L. Miessler and Donald A. Tarr, 4th Ed. 2010, Prentice Hall ISBN 10:0136128661.*** • ***The organometallic chemistry of the transition metals, Robert H. Crabtree, 4th Ed, 2005, John Wiley & Sons, Inc., ,10 9 8 7 6 5 4 3 2 1.***
Electronic Materials	• ***Blackboard*** • ***http://home.cc.umanitoba.ca/~budzelaa/CHEM4680/CHEM4680_lectures.html*** • ***http://chem-faculty.lsu.edu/stanley/webpub/4571-chap5-hydrides.pdf***

Other Learning Materials	**Comprehensive Inorganic Chemistry**. Sulekh Chandra, New Age International Limited Publishers, New Delhi, 2004 Descriptive inorganic chemistry, Rayner-Canham, Geoff., Publisher: W.H. Freeman, New York, 2006

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

H. Course Quality Evaluation

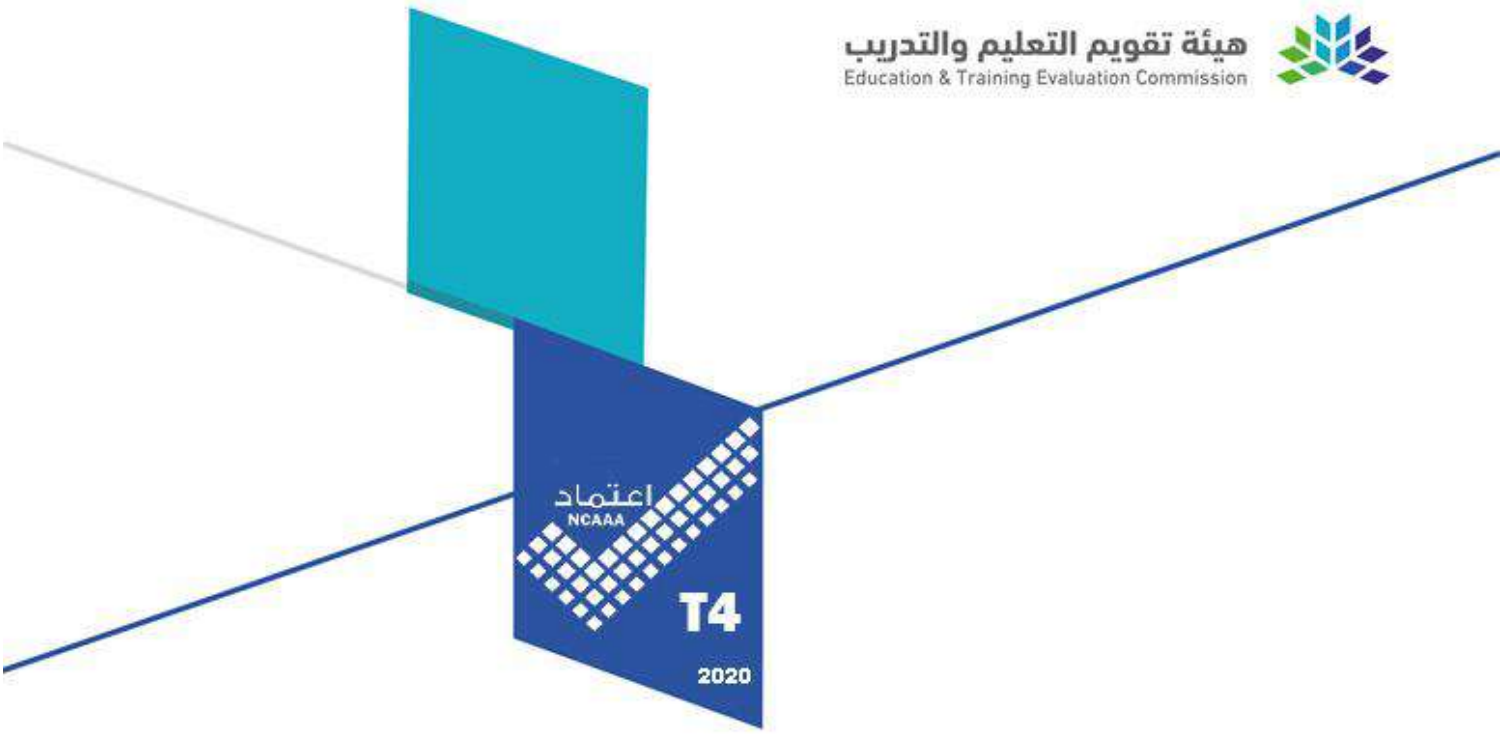
Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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)

I. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Heterocyclic Chemistry**
Course Code:	**CHM 325**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**4 (4 Lectures, 0 Lab, 0 Tutorials)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 5 / Year 2**
4. Pre-requisites for this course (if any)**:**	**Organic chemistry (2) –CHM 221**
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**	**40**	**100 %**
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**40**
2	**Laboratory/Studio**	**0**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**40**

B. Course Objectives and Learning Outcomes

1. Course Description

This course provides students with an introduction to heterocyclic chemistry, methods, reactivity and application of heterocyclic compounds in medicinal chemistry and industry. Topics covered in the course include a structure of heterocycles, Heterocycles with three members with one heteroatom, Structure of Five-membered Rings with One Heteroatom, Structure of Five-membered Rings with Two or More Heteroatoms, Structure of Six-membered Rings with One Heteroatom, Heterocycles with Six members with Two or More Heteroatoms, Biologically important heterocycles.

2. Course Main Objective

At the end of this course the student will be able to:

- **To list the structures of important classes of Heterocyclic Aromatic Compounds.**

- **To state electron deficient or electron rich in heterocyclic compounds.**
- **To write sequences for some heterocyclic compounds synthesis under the influence of reaction conditions.**
- **To memorize preparation and reactions of organic compounds.**
- **To describe preparation and reactions of five, six and fused member ring.**

To list the basic reactions covered in the required basic organic chemistry course.

3. Course Learning Outcomes

	CLOs	AlignedPLOs
1	**Knowledge and Understanding**	
1.1	**To recognize the structures of important classes of Heterocyclic Aromatic Compounds and to memorize the Synthetic methods of Organic Compounds**	**K1; K3;**
1.2	**To write sequences of Heterocyclic Compounds Synthesis in different reaction conditions.**	**K1; K3; S1; S3**
1.3	**To state and differentiate electron deficient or electron rich in Heterocyclic Compounds in terms of reactivity and to write the appropriate the reaction mechanism used for synthesis**	**K1; K3; S1; S3**
2	**Skills :**	
2.1	**To explain the reactivity of Heterocyclic Compounds towards a series of reagents**	**K1; K3; S1; S3**
2.2	**To plan and predict Heterocyclic Compounds synthesis providing by appropriate reaction mechanism.**	**K1; K3; S1; S3**
2.3	**To evaluate and predict the reactivity of Heterocyclic Compounds according to heteroatoms and functional groups attached.**	**K1; K3; S1; S3**
2.4	**Operate Laboratory Instruments and Perform chemical experiments during Laboratory Classes and Demonstrate Oral Communication to carry out heterocyclic compounds synthesis and its reactivity towards a series of reagents, with improving technical writing skills through writing of mini- Reports, with operating electronic mail and Network in communicating with others.**	**K1, S2; S3; S4**
3	**Values:**	
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	**V1; V2**

C. Course Content

No	List of Topics	Contact Hours
1	**Structure of Heterocycles:** Introduction, Relationship of Heterocyclic and Carbocyclic Aromatic Compounds, Systematic Nomenclature, The Relation between Benzene Ring and the Heterocyclic Rings, Aromaticity Rules, Nomenclature of Heterocyclic Compounds of Five and Six Member-ring with Two Heteroatom's, Fused with Benzene Ring, Fused Heterocyclic Ring Systems,	**8**
2	**Heterocycles with three members with one heteroatom:** Different Methods for the Preparation of Oxirane, Formation of Aziridines using Haloamines, Methylene Insertion Reactions. Some Examples of Nucleophilic and Electrophilic Ring Openings.	**3**
3	**Structure of Five-membered Rings with One Heteroatom:** Reactivity of Five-membered Rings with One Heteroatom, Electrophilic attack, Nucleophilic attack,	**5**

	Nucleophilic Attack at Nitrogen Heteroatom, Nucleophilic Attack at Hydrogen Attached to Ring Carbon or Ring Nitrogen, Benzo derivatives of Five-membered Heterocycles with One Heteroatom.	
4	**Structure of Five-membered Rings with Two or More Heteroatoms:** Azoles with Heteroatoms in the 1,2-positions, Azoles with Heteroatoms in the 1,3-positions, Reactivity of Five-membered Rings with Two or More Heteroatoms	**5**
5	**Structure of Six-membered Rings with One Heteroatom:** Reactivity of Six-membered Rings with One Heteroatom (Pyran, Thiopyran, Pyridine), Electrophilic attack, Nucleophilic attack, Nucleophilic Attack at Nitrogen Heteroatom, Nucleophilic Attack at Hydrogen Attached to Ring Carbon or Ring Nitrogen, Benzo derivatives of Six-membered heterocycles with one heteroatom.	**8**
6	**Heterocycles with Six-members with Two or More Heteroatoms:** Structure and Reactivity of Aromatic Six-Membered Systems with two or More Heteroatoms, Synthesis and Reactivity of 1,2- and 1,4- and 1,3-Diazines such as Pyrimidines; Six-membered Ring Systems with Three and More Heteroatoms: Triazines, Tetrazines, Oxadiazines and Oxathiazines.	**5**
7	**Biologically important heterocycles:** Pyrimidines, and Purines, structure, synthesis, Nucleic acids and enzymes, the Biological Processes	**3**
Revisions.		**3**
Total		**40**

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1.0	**Knowledge and Understanding**		
1.1	**To recognize the structures of important classes of Heterocyclic Aromatic Compounds.**	▪ Three hours are weekly containing lectures and Group Discussion ▪ A Private study including home exam.	▪ Quizzes Assignments ▪ Discussions. ▪ Participation.
1.2	**To write sequences of Heterocyclic Compounds Synthesis in different reaction conditions.**	▪ Three hours are weekly containing lectures, and group discussion	▪ Quizzes Assignments. • Oral Discussion marks
1.3	**To state and differentiate electron deficient or electron rich in Heterocyclic Compounds in terms of reactivity.**	▪ Three hours are weekly for lectures, and group discussion ▪ Think and talk about reactivity of heterocyclic compounds	• Midterms. • Assignments • Oral Discussions. • Quizzes.
2.0	**Skills**		
2.1	**To explain the reactivity of Heterocyclic Compounds towards a series of reagents**	▪ Lectures activity ▪ Think and talk about the reactivity of	▪ Questions in Lectures. ▪ Short Quizzes and

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
		heterocyclic Compounds	Exams. ▪ Participation ▪ Oral Discussion, ▪ Home Exam.
2.2	**To plan and predict Heterocyclic Compounds synthesis providing by appropriate reaction mechanism.**	▪ Encourage students to communicate their logic chemical thinking, and to work and discuss cooperatively with their peers to develop individual skills.	● Questions in Lectures. ● Participation through Oral Discussion ● Short Quizzes and Exams.
2.3	**To evaluate and justify the reactivity of Heterocyclic Compounds according to heteroatoms and functional groups attached.**	▪ Lectures and Oral Discussions. ▪ Brain storming Exercises	▪ Questions in Lectures. ▪ Short Quizzes and Exams.
2.4	**Demonstrate Oral Communication to carry out heterocyclic compounds synthesis and its reactivity towards a series of reagents orally and mentally, with improving technical writing skills through writing of mini- Reports, with operating electronic mail and Network in communicating with others.**	▪ Group Discussion and Assignments ▪ Introduce several reports on Synthesis and Reactivity of Heterocyclic Compounds for reading, writing, and oral presentation. ▪ Encourage students to use electronic mail to submit Home Exams and Assignments	▪ Oral Discussion, Quizzes, and Exams. ▪ Giving marks for Oral Discussion in Lectures. ▪ Marks given for Assignments
3.0	**Values**		
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	▪ Brain Storms Exercises ▪ Group Discussion	● Oral Discussion. ▪ Group Discussion and Assignments

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Home Exams**	**All the semester**	**20 %**
2	**Midterm Exam 1**	**Around 5th week**	**20 %**
3	**Midterm Exam 2**	**Around 8th week**	**20 %**
4	**Final Exam**	**Around 11th– 12th week**	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Heterocyclic Chemistry, Joule, John A., Mills. K., Wiley-Blackwell, 5th Ed. (2010), ISBN: 978-1-4051-3300-5.*** • ***Handbook of Heterocyclic Chemistry, Katritzky, A. R.; Pozharskii, A. F.; 2nd Ed. (2000); Pergamon: Oxford. ISBN: 978-0-08-095843-9***
Essential References Materials	***1. Heterocyclic Chemistry Gilchrist, T. L.; Addison Wesley Longman: Edinburgh Gate, 3rd Ed. (1997), ISBN-10: 0582278430*** ***2. Vogel's' Textbook of Practical Organic Chemistry, Vogel, A.I., Tatchell, A.R. , Furnis, B.S , Smith, P.W.G , Longman Group UK Limited, (5th Ed.), 1989 ISBN 978-0-582-46236-6*** • ***3. Heterocyclic chemistry; Gilchrist, T. L. (3rd Ed.), Prentice Hall:, 1979, ISBN:9780582278431.***
Electronic Materials	• **Blackboard** • **http://www.sigmaldrich.com**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Synthesis of Organic Compounds**
Course Code:	**CHM 326**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**2 (0 Lectures, 4 Lab, 0 Tutorials)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 7 / Year 3**
4. Pre-requisites for this course (if any)**:**	**Heterocyclic Chemistry - CHM 325**
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**	**40**	**100%**
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other (Lab)**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**0**
2	**Laboratory/Studio**	**40**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**40**

B. Course Objectives and Learning Outcomes

1. Course Description

A laboratory course designed to provide students with experience in single-step and multi-step syntheses, purifications and characterization of organic molecules with hands-on access to available instruments and techniques.

2. Course MainObjective

At the end of this course the student will be able to:

- To memorize the Synthetic methods of Organic Compounds
- To recognize one and multi-step technique used forselected organic compounds synthesis
- To list the required reactions covered in the Organic Chemistry Courses used for target synthesis.
- To write the appropriate the reaction mechanism used for synthesis.

- To outline the possible problems that might be faced during the synthesis, with proposed solutions.

3. Course Learning Outcomes

	CLOs	AlignedPLOs
1	**Knowledge and Understanding**	
1.1	**To memorize the Synthetic methods of Organic Compounds**	**K1; K3;**
1.2	**To list the required reactions covered in the Organic Chemistry Courses used for target synthesis.**	**K1; K3; S2**
1.3	**To write the appropriate the reaction mechanism used for synthesis.**	**K3; S1; S4**
2	**Skills:**	
2.1	**To explain the reactivity of organic compounds.**	**K1; K3; S1; S3**
2.2	**To predict the reaction mechanisms of target compound synthesis.**	**S1; S3**
2.3	**To summarize the possible methods for synthesis of target compounds**	**S1; S3**
2.4	**Operate Laboratory Instruments and Perform chemical experiments during Laboratory Classes and Demonstrate Oral Communication and technical writing skills through writing of Laboratory Reports.**	**K1; S2; S4; V2**
3	**Values:**	
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	**V1; V2**

C. Course Content

No	List of Topics	Contact Hours
Lab. 1	Synthesis of 2,5-Dimethyl pyrrole: Pyrrole can be prepared from 1,4-Diketone in the Presence of Ammonium Carbonate.	**4**
Lab. 2	Synthesis of Hexahydro-1,3,5-tri-*p*-tolyl-*s*-triazine: Hexa hydro-1,3,5-tri-*p*-tolyl-*s*-triazine can be prepared by the reaction of *p*-toluidine with formaldehyde at room temperature.	**4**
Lab. 3	Synthesis of 2,3-diphenylquinoxaline: 2,3-diphenylquinoxaline can be prepared by the reaction of benzil with *o*-phenylenediamine.	**4**
Lab. 4	Synthesis of 5,5-Diphenylhydantoin: 5,5-Diphenylhydantoin can be prepared by the reaction of benzil with urea in the presence of a base.	**4**
Lab. 5	Synthesis of benzimidazole: Benzimidazole can be prepared by the reaction of *o*-phenylenediamine with formic acid under refluxing.	**4**
Lab. 6	Synthesis of Benzotriazole: Benzotriazole can be prepared by the reaction of *o*-phenylenediamine with nitrous acid.	**4**
Lab. 7	Synthesis of 3-Methyl-1-phenyl-5-pyrazolone: 3-Methyl-1-phenyl-5-pyrazolone can be prepared by the reaction of ethyl acetoacetate with phenylhydrazine.	**4**
Lab. 8	Synthesis of Pyrano pyrazole:3-Methyl-1-phenyl-5-pyrazolone can be reacted with α,β-unsaturated nitriles affording fused pyrazole	**4**

Lab. 9	Synthesis of Pyridine Derivatives: Pyridine derivatives can be prepared from chalcones and active methylene comounds	**4**
Lab. 10	Synthesis of Barbituric Acid: Barbituric acid can be prepared by the reaction of diethylmalonate with urea in the presence of sodium ethoxide.	**4**
Total		**40**

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	Assessment Methods
1.0	**Knowledge and Understanding**		
1.1	**To memorize the Synthetic methods of Organic Compounds**	• Four hours are weekly containing Laboratory activities and Oral Discussion. • A Private study including work on writing report.	• Laboratory Reports. • Oral Discussion marks • Participation.
1.2	**To list the required reactions covered in the Organic Chemistry Courses used for target synthesis.**	• Four hours are weekly containing Laboratory activities with group discussion. • Think and discuss about Required Organic Reactions	• Lab. Reports. • Oral Discussions.
1.3	**To write the appropriate the reaction mechanism used for synthesis.**	• Four hours are weekly containing Laboratory activities with group discussion. • Think and talk about the used reaction mechanism	• Laboratory Reports • Oral Discussions.
2.0	**Skills**		
2.1	**To explain the reactivity of organic compounds.**	• Laboratory activities • Think and talk about the reactivity of organic compounds.	• Questions in labs. • Participation through Laboratories • Oral Discussion,
2.2	**To predict the reaction mechanisms of target compound synthesis.**	• Encourage students to communicate their logic chemical thinking, and to work and discuss cooperatively with their peers to develop individual skills.	• Questions in labs. • Participation through Laboratories • Oral discussion

Code	Course Learning Outcomes	TeachingStrategies	Assessment Methods
2.3	**To summarize the possible methods for synthesis of target compounds**	• labs and Group discussion • Have the ability to ask and answer questions as they arise • Brain storming Exercises	• Questions in labs. • Participation through Laboratories • Oral discussion.
2.4	**Operate Laboratory Instruments and Perform chemical experiments during Laboratory Classes and Demonstrate Oral Communication and technical writing skills through writing of Laboratory Reports.**	• Encourage the students to use the Chemicals Glass wares and Instruments with caring and safety	• Laboratory report Marks. • Discussion marks • Giving marks for participation in the lab.
3.0	**Values**		
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	• Brain Storms Exercises • Group Discussion	• Oral Discussion. • Group Discussion and Assignments

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Lab. Reports**	**All the semester**	**30 %**
2	**Midterm Exam**	**Around 5th -6th week**	**30 %**
4	**Final Exam**	**Around 11th– 12th week**	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Vogel's' Textbook of Practical Organic Chemistry***, Vogel, A.I., Tatchell, A.R. , Furnis, B.S , Smith, P.W.G , Longman Group UK Limited, 5th Ed. 1989 ISBN 978-0-582-46236-6
Essential References Materials	• ***Heterocyclic chemistry***; Gilchrist, T. L. 3rd ed.;1997, Prentice Hall:, ISBN:9780582278431. • ***Heterocyclic chemistry***; Joule, J. A.; Mills, K , 5th edition, 2010, Wiley-Blackwell; ISBN: 978-1405133005
Electronic Materials	• **Blackboard** • **http://www.sigmaldrich.com**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each Laboratory should be equipped with maximum 20 seats K1; S2;** • **C2**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.

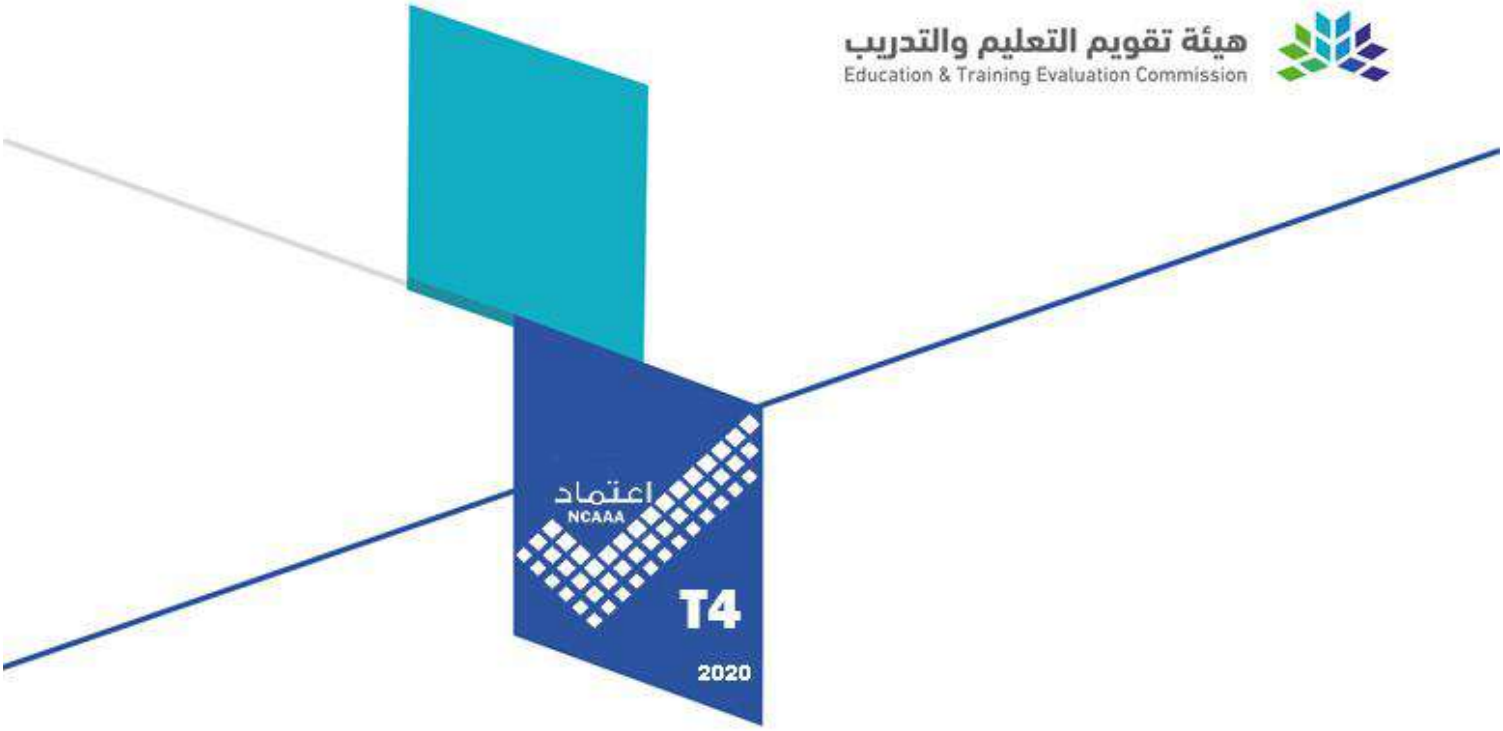
Evaluation Areas/Issues	Evaluators	Evaluation Methods
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Organic Reactions Mechanism**
Course Code:	**CHM 327**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**3 (3 Lectures, 0 Lab, 0 Tutorials)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 8 / Year 3**
4. Pre-requisites for this course (if any)**:**	**Heterocyclic Chemistry - CHM 325**
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	30	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

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

B. Course Objectives and Learning Outcomes

1. Course Description

This course provides students with an Introduction for Organic Reactions Mechanism, which covers all aspects; kinetic and physical methods to determine organic reaction mechanism; classifications of reaction mechanism; Substitution; Addition; Elimination; Radical Addition Reaction and Rearrangement.

2. Course Main Objective

At the end of this course the student will be able to:

- **Recall knowledge of core organic chemistry.**
- **Describe advanced organic chemistry topics including reaction mechanism, advanced synthetic procedures and strategy.**
- **Reproduce knowledge of quantitative understanding of reactions and proposing potential improvements to existing processes in organic chemistry.**
- **Recognize appropriate mechanism in organic synthesis.**
- **Define factors influence the chemical reaction mechanism.**

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recall knowledge of core organic chemistry.**	**K1; K3;**
1.2	**To describe advanced organic chemistry topics including reaction mechanism advanced synthetic procedures and strategy.**	**K1; K3; S1; S3**
1.3	**To recognize and define appropriate mechanism and factors influence the organic synthesis.**	**K1; K3; S1; S3**
2	**Skills:**	
2.1	**To Evaluate knowledge and understanding of essential facts, concepts and principles of physical organic chemistry.**	**K1; K3; S1; S3**
2.2	**To analyze problems and plan strategies for their solution, critically review different approaches to problems and demonstrate good research design.**	**K1; K3; S1; S3; S4**
2.3	**To Summarize concepts of reaction mechanism leading to logic thinking, followed by evaluation gained information.**	**K1; K3; S1; S3; S4**
2.4	**Demonstrate Oral Communication to carry out Chemical Reactions Sequence orally and propose a reaction mechanism and writing of mini- Reports, with operating electronic mail and Network in communicating with others.**	**S1, S4**
3	**Values:**	
3.1	**To demonstrate responsibility for their own learning and motivate for team work**	**V1;V2**

C. Course Content

No	List of Topics	Contact Hours
1	**An Overview of Organic Reactions**: Understanding Organic Reaction, kinds of organic reactions, How Organic Reactions occur: Mechanisms, Steps in Mechanisms, Types of Steps in Reaction Mechanisms, Energy diagram of any Reaction, Kinetics of the Reaction, Hybridization, Conjugation, Aromaticity, Inductive Effect, Mesomeric Effect	**2**
2	**Nucleophilic Substitution**: Relation of Kinetics to mechanism, Effect of solvent, Effect of structure, Stereochemical implications of mechanism, Stability of Carbocatios, *SN*1 Mechanism, Sources of Carbocations Stability, Effect of Entering and Leaving Groups, *SN2* Mechanism Inversion of Configuration, Determination of Relative Configuration, Effect of Entering and Leaving Groups, Other Nucleophilic Displacements	**6**
3	**Electrophilic Aromatic Substitution**:Electrophilic Attack on Benzene (π,σ complexes), Nitration, Halogenations, Sulphonation, Friedle- Crafts Reactions (Alkylation, Acylation), Diazo Coupling, Electrophilic Attack on C_6H_5Y (Y= $+NR_3$, CCl_3, NO_2, CHO, COOH etc., Y= OCOR, NHCOR, OR, OH, NH_2, NR_2, Partial Rate Factors and Selectivity, *O,P* Ratios, Electrophilic Substitution of Other Aromatic.	**4**
4	**Electrophilic and Nucleophilic Addition Reaction:** Electrophilic and Nucleophilic Addition Reaction to C=C,Addition of Halogens, Effect of Substitutions on Rate of Addition, Orientation of Addition, Other Addition Reactions (Further Halogen Derivatives, Hydration, Carbocations, Hydroxylation, Hydrogenation, Ozonolysis), Addition to Conjugated Dienes (Electrophilic addition, Diels- Alder Reaction	**6**
5	**Elimination Reaction:** 1,2-(β-) Elimination, E1 Mechanism, E1Cb Mechanism,	**2**

	E2 Mechanism (Stereoselectivity in E2, Orientation in E2 Saytzev v. Hoffmann), Elimination v. Substitution, Effect of activating groups, Other 1,2-Elimination, 1,2-(α-) Elimination, Pyrolytic Syn Elimination.	
6	**Reaction Intermediate:** Carbocation, Carboanion and Free Radical Formation, Carbene Formation and Reaction, Nitrene Formation and reactions, Arene-benzyne Formation and Reaction	**2**
7	**Radical Addition Reactions, Radical and Radicals Reaction and its application in biology**: Production of Radicals, Reaction of Radicals, Homolytic Bond Dissociation, Reaction of Alkanes with Halogen, Chlorination of Methane, Radicals in Biology, Superoxide SOD and Antioxidant, Drugs based on Radicals.	**4**
8	**Rearrangement and Fragmentation Reaction:** Cationic Rearrangement, Anionic Rearrangement, Radical Rearrangement, Factors Influence these Rearrangements.	**4**
Total		**30**
Topics to be covered (Laboratories)		

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1.0	**Knowledge and Understanding**		
1.1	**To recall knowledge of core organic chemistry.**	• **Lectures and Group Discussion** • **A Private study including home exam.**	• **Quizzes Assignments** ▪ **Discussions.** ▪ **Oral Discussion** ▪ **Participation.**
1.2	**To describe advanced organic chemistry topics including reaction mechanism advanced synthetic procedures and strategy.**	• **Lectures, and group discussion**	• **Quizzes Assignments.** • **Oral Discussion marks**
1.3	**To recognize and define appropriate mechanism and factors influence the organic synthesis.**	▪ **Lectures, and group discussion** ▪ **Think and talk about reactivity of heterocyclic compounds**	• **Midterms.** • **Assignments** • **Oral Discussions.** • **Quizzes.**
2.0	**Skills**		
2.1	**To Evaluate knowledge and understanding of essential facts, concepts and principles of physical organic chemistry.**	▪ **Lectures activity** ▪ **Think and talk about the reactivity of Organic Compounds and functional groups.**	▪ **Questions in Lectures.** ▪ **Short Quizzes and Exams.** ▪ **Participation** ▪ **Oral Discussion,** ▪ **Home Exam.**
2.2	**To analyze problems and plan strategies for their solution, critically review different approaches to problems and**	• **Introduce some examples of Organic Reactions from Previous**	• **Questions in Lectures.** • **Participation through Oral**

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
	demonstrate good research design.	**courses achieving Brainstorming.**	**Discussion** • **Short Quizzes and Exams.**
2.3	**To Summarize concepts of reaction mechanism leading to logic thinking, followed by evaluation gained information.**	• Lectures and Oral Discussions. • Brain storming Exercises	• Questions in Lectures. • Short Quizzes and Exams.
2.4	**Demonstrate Oral Communication to carry out Chemical Reactions Sequence orally and mentally, and propose a simple reaction mechanism improving technical writing skills through writing of mini- Reports, with operating electronic mail and Network in communicating with others.**	• Group Discussion and Assignments • Introduce several reports about examples of reaction mechanism in English, which will require reading, writing, and oral presentation. ▪ Encourage students to use electronic mail to submit Home Exams and Assignments	▪ Oral Discussion, Quizzes, and Exams. ▪ Giving marks for Oral Discussion in Lectures. ▪ Marks given for Assignments
3.0	**Values**		
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	• Brain Storms Exercises • Group Discussion	• Oral Discussion. • Group Discussion and Assignments

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Home Exams**	**All the semester**	**20 %**
2	**Midterm Exam 1**	**Around 5th - 6thweek**	**20 %**
	Midterm Exam 2	**Around 8th week**	**20 %**
3	**Final Exam**	**Around 11th– 12th week**	**40 %**
4	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**

- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	***A Guidebook to Mechanism in Organic Chemistry, Peter Sykes, Pearson; 6 edition 6th Ed., 1996 | ISBN-10: 0582446953***
Essential References Materials	▪ ***Arrow-Pushing in Organic Chemistry: An Easy Approach to Understanding Reaction, John Wiley & Sons, Inc., 2011, ISBN10: 978-1-118-21045-1*** ▪ ***MARCH'S Advanced Organic Chemistry, Reactions, Mechanisms, and Structure, Michael B. Smith, Jerry March, John Wiley & Sons, Inc., 7th Ed., 2007. ISBN: 978-0-470-46259-1***
Electronic Materials	• **Blackboard** • **Journal of Organic Chemistry, ACS** • **Organic Letters, ACS** • **Tetrahedron** • **Tetrahedron Letters** • **Organic and Biomolecules Chemistry, RSC** • **European Journal Of Organic Chemistry** • **http://www.sigmaldrich.com**
Other Learning Materials	• ***A Guidebook to Mechanism in Organic Chemistry, Peter Sykes, Pearson; 6 Edition 6th Ed., 1996, | ISBN-10: 0582446953.***

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner

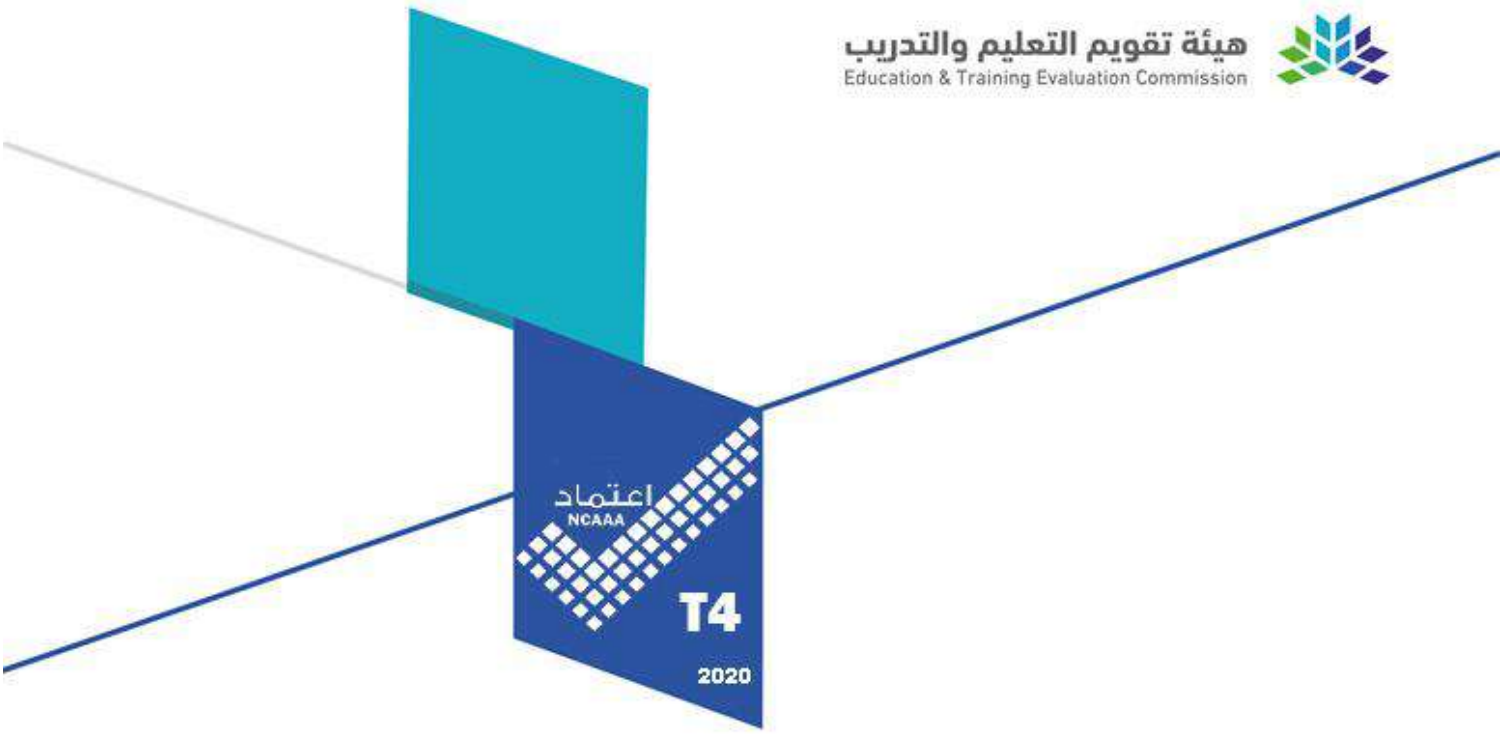
Evaluation Areas/Issues	Evaluators	Evaluation Methods
		checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio.
	Course Responsible	**Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Instrumental Analysis**
Course Code:	**CHM 332**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

A. Table of Contents

B. Course Identification

1. Credit hours:	**4(3 Lectures, 3 Lab and Tutorial)**
2. Course type	
a. University ☐ College ☐ Department ☑ Others ☐	
b. Required ☑ Elective ☐	
3. Level/year at which this course is offered:	**Level 5/Year 2**
4. Pre-requisites for this course (if any)**:**	**Analytical chemistry– CHM 231**
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**	**60**	**100%**
2	**Blended**		
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**30**
2	**Laboratory/Studio**	**30**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**60**

C. Course Objectives and Learning Outcomes

1. Course Description:

The topics taught in this course include Electromagnetic spectrum and its properties, spectrometers, Ultra violet and visible, infrared and Raman, atomic absorption and atomic emission, molecular emission, NMR and X-rays.

2. Course Main Objective: ***This course is intended:***

- To improve students' knowledge of instrumental analysis by providing them with basic concepts, functionality of different instrumental techniques.
- To develop their hand on skills to use the different instruments and obtain results using appropriate techniques.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recall the basic principles of instrumental analytical techniques.**	**K1, K2**
1.2	**To recognize the components and role of instruments in solving problems in the physical, chemical and biological samples.**	**K2, K3**
1.3	**To tell the meaning of, and how, to estimate absorbance, transmittance and concentrations.**	**K2**
2	Skills :	
2.1	**To operate main instrumental analysis devices and explain the complexity of each instrument, its strength and limitation.**	**S1**
2.2	**To practice measuring different variable using spectroscopic lab instruments and differentiate between various types of instruments in terms of parts and functions.**	**S1**
2.3	**To prepare standard solution using different laboratory equipment and operate and calibrate instruments during laboratory classes and illustrate the ability to present data in graphs to obtain experimental variables**	**S1, S4**
2.4	**To demonstrate oral communication skills by presenting seminars before his class mates and teaching staff, to write reports about real pollution cases in his community and operate electronic mail and Network skills in communicating with others.**	**S2, S3**
3	Values:	
3.1	**To Appraise teamwork, decision-making in unpredictable work, and management of resources and time. Avoid over consumption of materials and chemicals and keep the lab instruments and equipment clean and safe.**	**V1, V2**

D. Course Content

No	List of Topics	Contact Hours
	Topics to be covered (Lectures and Tutorial)	
1	**Introduction to Spectroscopy:** Electromagnetic spectrum, relationships between frequency, wavelength and E, components of an optical spectrometer	**4**
2	**Atomic Absorption Spectroscopy:** Energy levels, selection rules, instrumentation. Sample atomization, flame and graphite furnace. Fuel, oxidants and interferences.	**2**
3	**Atomic Emission Spectroscopy:** Emission of radiation, ground and excited states, flame photometer, instrument anatomy, Inductively Coupled Plasma (ICP), comparison with flame photometry.	**4**
4	**Molecular Absorption Spectroscopy:** Ultraviolet and visible spectroscopy, electronic levels and electronic transitions, instrumentation. Beer' -Lambert law, transmittance and absorbance, relation. Infrared spectroscopy Dipole moment, molecular stretching and bending vibrations, instrumentation. Raman spectroscopy and polarizability change.	**4**
5	**Molecular Emission Spectroscopy:** Molecular orbitals, absorption and emission, singlet and triplet states, fluorescence, phosphorescence	**4**
6	**Nuclear Magnetic Resonance:** Spin and magnetic quantum numbers. Relationship between nuclear spin and magnetic field H0. H-NMR, ^{13}C-NMR.	**8**

7	**X-ray techniques:** X-ray fluorescence. Energy levels leading of X-ray emission. Auger electrons. Instrumentation, production of electrons and X-rays, XRF.	**2**
8	**Electrochemical Techniques:** Nernst equation, cyclic voltammeter, pH meter and other ion-selective electrodes, Polarography.	**2**
Topics to be covered (Laboratories)		
1	Safety and Laboratory equipment's and measurements and reports & Introduction to UV-Vis spectrometer and its operation. Single and double beam.	**3**
2	Verification of transmittance-absorbance relation & Standard addition method for determination of an unknown concentration using Beer's law for determination of an unknown concentration.	**3**
3	Determination of the equilibrium constant for ferric thiocyanate complex using spectrophotometer	**3**
4	Titration of an acid and a base using pH meter & Titration of an acid and a base using conductivity meter	**3**
5	Determination of elemental content of a sample by ICP	**3**
6	Determination of an IR spectrum of some organic compounds	**3**
7	Determination of alkali metal concentrations using flame photometer (1)	**3**
8	Determination of alkali metal concentrations using flame photometer (2)	**3**
9	Cyclic voltammeteric study of potassium ferricynide /ferrocynide system.	**3**
10	Determination of Cl^-, H^+, SO_4^{2-}, and NO_3^- using ion selective electrodes	**3**
Total		**60**

E. 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**		
1.1	To recall the basic principles of instrumental analytical techniques.	lecturing	Short quizzes
1.2	To recognize the components and role of instruments in solving problems in the physical, chemical and biological samples.	Lecturing, group discussions, Homework and assignment	Oral test, Homework and assignment marks and written exams
1.3	To tell the meaning of, and how, to estimate absorbance, transmittance and concentrations.	Tutorials and laboratory experiments.	Participation, Quizzes and MCQs, laboratory reports
2.0	**Skills**		
2.1	To operate main instrumental analysis devices and explain the complexity of each instrument, its strength and limitation.	Lecturing, group discussion and laboratory experiments	Short quizzes Exams, Homework assignment and laboratory reports
2.2	To practice measuring different variable using spectroscopic lab instruments and differentiate	Lectures and laboratory sessions	Quizzes

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	between various types of instruments in terms of parts and functions.		
2.3	To prepare standard solution using different laboratory equipment and operate and calibrate instruments during laboratory classes and illustrate the ability to present data in graphs to obtain experimental variables	Lecturing and oral discussion supported by laboratory experiments	Homework assignment, Examination and laboratory report
2.4	To demonstrate oral communication skills by presenting seminars before his class mates and teaching staff, to write reports about real pollution cases in his community and operate electronic mail and Network skills in communicating with others.	• Oral participation • Group discussions and lab experiment and reports • Encourage students to use electronic mail to submit homework and assignments.	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks
3.0	**Values**		
3.1	To Appraise teamwork, decision-making in unpredictable work, and management of resources and time. Avoid over consumption of materials and chemicals and keep the lab instruments and equipment clean and safe.	• Group discussion, assignments and homework • Lab-reports • Virtual labs and demonstrations	• Oral tests, lab performance, Lab-reports and sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Homework**	**All the semester**	**10 %**
2	**Laboratory**	**All the semester**	**30 %**
3	**Midterm Exam 1**	**Around 5th week**	**10 %**
4	**Midterm Exam 2**	**Around 8th week**	**10%**
5	**Final Exam**	**Around 11th– 12thweek**	**40 %**
6	**Total**		**100%**

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

F. Student Academic Counseling and Support

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

- **There are two office hours per week reserved by each staff member, planned on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counselling.**

G. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	• ***Principles of Instrumental Analysis***", D. A. Skoog, F. J. Holler, S.R. Crouch,; 6th Ed. (2006) , Brooks Cole, ISBN: 0495012017 , 978-0495012016
Essential References Materials	• ***Quantitative Chemical Analysis***, Daniel C. Harris, 8th Ed., 2010, W. H. Freeman & Co., New York, ISBN: 9781429218153. • ***Undergraduate Instrumental Analysis***, James W. Robinson, Eileen M. Skelly Frame, George M. Frame II, 6th Ed., 2004, CRC Press.
Electronic Materials	• **Blackboard** • **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true** • **http://www.chem1.com/acad/webtext/virtualtextbook.html** • **http://www.shodor.org/UNChem/index.html**
Other Learning Materials	**Internal server: www. Elesevier.com**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

H. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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)

I. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Chemical Separation Methods**
Course Code:	**CHM 333**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

A. Table of Contents

B. Course Identification

1. Credit hours: 4 (2 Lectures, 3 Lab, 1 Tutorial)
2. Course type **a.** University ☐ College ☐ Department ☐ Others ☐ **b.** Required ☐ Elective ☐
3. Level/year at which this course is offered: Level 6/Year 2
4. Pre-requisites for this course (if any)**: Analytical Chemistry – CHM 231**
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**	**60**	**100%**
2	**Blended**		
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**30**
2	**Laboratory/Studio**	**30**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**60**

C. Course Objectives and Learning Outcomes

1. Course Description:

Classical separation methods, extraction, chromatography (TLC, GC, HPLC, Column chromatography), detectors, ion exchange and electrophoresis.

2. Course Main Objective: ***This course is intended:***

- The main objective of this course is to familiarize students with the fundamental of separation processes used in analytical chemistry such as various extraction techniques, gas and liquid chromatography, size and ion chromatography and electrophoresis.
- By completion of this course, students, are expected to gain independent laboratory skills in certain separation techniques and will have the ability to interpret data from analytical separation methods.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To outline principles of chemical separations and construction of relevant instrumentation.**	**K1, K2, K3**
1.2	**To name factors that affect performance of chemical separation methods especially GC and HPLC and optimize respective operating conditions.**	**K2, K3**
1.3	**To describe experimental methods to separate plant extract components**	**K1, K2**
2	Skills :	
2.1	**To operate and calibrate separative techniques and use the appropriate types of detectors such as ECD, FID, NPD, Diode-Array and mass-spectrometer.**	**S1**
2.2	**To identify the scientific separation methods employed in multidisciplinary fields such as environmental and pharmaceutical analysis.**	**S1, S3**
2.3	**To design experimental setup for separation of compounds with different properties such as polarity and solubility.**	**S1, S4**
2.4	**To demonstrate oral communication skills by presenting seminars before his class mates and teaching staff, to write reports about real pollution cases in his community and operate electronic mail and Network skills in communicating with others.**	**S2, S3**
3	Values:	
3.1	**To Build self-confidence attitudes through single and team work practical sessions, presentations, and discussions. Avoid over consumption of materials and chemicals and keep the lab instruments and equipment clean and safe.**	**V1, V2**

D. Course Content

No	List of Topics	Contact Hours
	Topics to be covered (Lectures and Tutorial)	
1	**Introduction to separation:** Pre-concentration , quantification, purity and role of separation**,** Classification of separation methods depending on the basis of separation**,** Classical separation methods, distillation, re-crystallization, filtration, decantation, and centrifugation, Introduction to the developed method of separation, requirements and specifications	6
2	**Extraction techniques**: theory and applications on liquid-liquid, liquid–solid , soild-pahse micro extractions and stir-bar sorptive extraction techniques, Comparison of the efficiency of various techniques, and methods improvement, Applications in various fields	4
3	**Chromatographic theory**: history of chromatography, classification of chromatographic methods, mechanism of separation, column efficiency, Band broadening and resolution, (HETP)theoretical plates, open column and chromatogram, layer chromatography(TLC) and paper chromatography and their applications	4
4	**Gas chromatography**: instrumental design, gas type selection, methods of sample introducing or injection(split, splitless , split-splitless and purge and trap, Types of detectors, (ECD, FID, NPD, PID) and connection to MS Columns(capillary and packed) , chemically bonded and comparing the efficiency, Temperature programmed (oven) and quantitative analysis (applications)	6

5	**High performance Liquid Chromatography**(HPLC): theory of operation, instrumental design , function of various parts of the machine , solvent delivery(pumps), types of pumps and requirements, Column specification and polarity, column selection, detectors (UV-Vis., Fluorescence , RI, Diode array,,) and connectivity to MS Operational modes of HPLC(Reverse and Normal phase) quantitative analysis and applications	6
6	**Ion chromatography, cation and anion exchange**: resin, and size exclusion chromatography, Electrophoresis, its principle and capillary electrophoresis.	4
Topics to be covered (Laboratories)		
1	Classical Separation of mixture depending on different physical and chemical properties & Separation and purification by Re-crystallization	**3**
2	Determination of Distribution Coefficients of iodine and benzoic acid in organic solvent/water system	**3**
3	Separation of organic mixture by distillation techniques: simple and fractional & Separation of mixture using liquid-liquid extraction technique	**3**
4	Separation of organic mixture and plant pigments by means of column chromatography	**3**
5	Separation and identification of pain killers and plant pigments using TLC & Separation of metal ions by Paper Chromatography	**3**
6	Separation of Chromium complexes by means of Cation exchanger (Resin).	**3**
7	Determination of Na+ by Ion-Exchange chromatography	**3**
8	Determination of Ca2+ by Ion-Exchange chromatography	**3**
9	Separation of organochlorine pesticides by Gas-chromatography	**3**
10	Separation and quantification of Caffeine in soft drinks using HPLC technique	**3**
Total		**60**

E. 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**		
1.1	To outline principles of chemical separations and construction of relevant instrumentation.	lecturing	Short quizzes
1.2	To name factors that affect performance of chemical separation methods especially GC and HPLC and optimize respective operating conditions.	Lecturing, group discussions, Homework and assignment	Oral test, Homework and assignment marks and written exams
1.3	To describe experimental methods to separate plant extract components	Tutorials and laboratory experiments.	Participation, Quizzes and MCQs, laboratory reports
2.0	**Skills**		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.1	To operate and calibrate separative techniques and use the appropriate types of detectors such as ECD, FID, NPD, Diode-Array and mass-spectrometer.	Lecturing, group discussion and laboratory experiments	Short quizzes Exams, Homework assignment and laboratory reports
2.2	To identify the scientific separation methods employed in multidisciplinary fields such as environmental and pharmaceutical analysis.	Lectures and laboratory sessions	Quizzes
2.3	To design experimental setup for separation of compounds with different properties such as polarity and solubility.	Lecturing and oral discussion supported by laboratory experiments	Homework assignment, Examination and laboratory report
2.4	To demonstrate oral communication skills by presenting seminars before his class mates and teaching staff, to write reports about real pollution cases in his community and operate electronic mail and Network skills in communicating with others.	• Oral participation • Group discussions and lab experiment and reports • Encourage students to use electronic mail to submit homework and assignments.	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks
3.0	**Values**		
3.1	To Build self-confidence attitudes through single and team work practical sessions, presentations, and discussions. Avoid over consumption of materials and chemicals and keep the lab instruments and equipment clean and safe.	• Group discussion, assignments and homework • Lab-reports • Virtual labs and demonstrations	• Oral tests, lab performance, Lab-reports and sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Homework**	**All the semester**	**10 %**
2	**Laboratory**	**All the semester**	**30 %**
3	**Midterm Exam 1**	**Around 5th week**	**10 %**
4	**Midterm Exam 2**	**Around 8th week**	**10%**
5	**Final Exam**	**Around 11th– 12thweek**	**40 %**
6	**Total**		**100%**

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

F. Student Academic Counseling and Support

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

- **There are two office hours per week reserved by each staff member, planned on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counselling.**

G. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	• *Quantitative Chemical Analysis*, Daniel C. Harris, 8th Ed., 2010, W. H. Freeman & Co., New York, ISBN: 9781429218153.
Essential References Materials	• *Modern Analytical Chemistry*, David Harvey, McGraw-Hill, 1st Ed, 2000, ISBN: 0–07–237547–7 • *Chemical Analysis: Modern Instrumentation Methods and Techniques*, Francis Rouessac, Annick Rouessac, John Wiley & Sons, 2nd, 2007.ISBN: 0470859040, 9780470859049. • *Principles of Instrumental Analysis*, D. A. Skoog, F. J. Holler, S.R. Crouch, Brooks Cole; sixth edition (2006), ISBN: 0495012017, 978-0495012016. • Chromatography: Fundamentals and applications of chromatography and related differential migration methods, Heftmann، E , 6th Ed, Elsevier Science, 2004., ISBN: 0444511067, 978-0444511065.
Electronic Materials	• Blackboard • http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true • http://www.chem1.com/acad/webtext/virtualtextbook.html • http://www.shodor.org/UNChem/index.html
Other Learning Materials	**Journal of chromatography. Encyclopedia of chemistry**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

H. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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)

I. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Electrochemistry and Corrosion**
Course Code:	**CHM 343**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 4 (3 Lectures, 3 Lab, and Tutorials)
2. Course type **a.** University ☐ College ☐ Department ✓ Others ☐ **b.** Required ✓ Elective ☐
3. Level/year at which this course is offered: Level 5 / Year 2
4. Pre-requisites for this course: Physical Chemistry (1) –CHM 241
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	60	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	30
2	Laboratory/Studio	30
3	Tutorial	0
4	Others (specify)	0
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

Topics covered in the course include the fundamentals of electrochemistry, cells, batteries and their standard potentials, Nernst equation, potentiometry and voltammetry methods, electrolytic conductance, corrosion.

2. Course Main Objective

At the end of the course, Students should be able to:

- ***To provide students with basics of electrochemical processes under standard and non-standard conditions.***
- ***To familiarize students with the principles of some electrochemical techniques.***
- ***To introduce corrosion and wear occurring to metals under different conditions.***
- ***To give summary of different technologies are used to prevent or minimize corrosion.***
- ***Solve mathematical problems to calculate cells potentials, amounts of metal deposited in electrolysis, conductivity, resistivity and current values.***
- ***Carry out experiments, collect data and derive relations and conclusions.***

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recognize some principles of electrochemistry.**	**K1; K2; K3**
1.2	**To state Nernst equation for a galvanic cell potential due to change of redox system.**	**K1; K2; K3**
1.3	**To memorize laws of conductivity, resistivity and related phenomena.**	**K1**
1.4	**To define corrosion and its impact upon metal integrity, and list methods of corrosion prevention**	**K1; K3**
2	**Skills :**	
2.1	**To evaluate the equilibrium constant from experimental data, and contrast kinetic data with Mathematical equations.**	**S1; S2; S3**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S2; S3**
2.3	**To demonstrate skills to participate in class by asking questions and giving answers.**	**S3**
2.4	**To diagram and explain experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	**S2;S4**
3	**Values:**	
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	**V1, V2**

C. Course Content

No	List of Topics	Contact Hours
1	• Introduction / Fundamental Concepts: Electrochemistry and Redox, Redox Review. Balancing Redox Reactions, Types of cells, Common Components, Electrolytic cells, Voltaic (Galvanic) Cells, Cell Potential. STANDARD POTENTIALS, Standard Reduction Potentials, E0cell and ΔG0, Calculating E0 cell, Nernst equation, Concentration Cells. Batteries, Fuel Cells, Electrolysis, Stoichiometry, Faraday constant (F).	**6**
2	• Practical Considerations: Electrochemical Cell, electroanalytical measurement, Potentiometric Technique, Potentiostatic Technique, voltammogram. Thermodynamics and Potentials. Ion-selective electrodes (ISE), glass electrodes, liquid membrane electrodes, solid-state electrodes, applications of ISEs. Steps in simple reactions, steps in complex reactions, electrode reaction pathway, reactions controlled by mass transport.	**6**
3	• Potentiometry: Potential step experiments, potential sweep experiments. Reactions controlled by rate of electron transfer, electrical double layer. Reactions & Interfacial Properties:Cyclic voltammetry, Reversible Systems, Irreversible Systems, Quasi-reversible Systems, Applications, spectroelectrochemistry, electrochemiluminescence (ecl), scanning probe microscopy.	**6**
4	• Electrode scanning tunneling microscopy (stm), atomic force microscopy (afm), scanning electrochemical microscopy (secm), electrochemical quartz crystal, microbalance (eqcm), impedance spectroscopy. Controlled potential techniques: Controlled potential, chronoamperometry, chronocoulometry,	**6**

	polarography, the ilkovic equation, pulse voltammetry, ac voltammetry, stripping analysis, flow analysis.	
5	• Chemical Corrosion: Electrochemical Corrosion, the Electrode Potential in Electrochemical Cells. Types of Electrochemical Corrosion, Protection Against Electrochemical Corrosion.	**6**
Total		**30**
Topics to be covered (Laboratories)		
Lab 01	Electrolysis of Water	**3**
Lab 02	Electrochemical Studies on Different Galvanic Cells	**3**
Lab 03	Electrochemical Studies on Concentration Cells.	**3**
Lab 04	Electroplating.	**3**
Lab 05	Determination Of Cell Constant.	**3**
Lab 06	Part1: Determination of Equivalent Conductance of a Strong Electrolyte. Part2: Dissociation Constant of Weak Acid.	**3**
Lab 07	Part1: Solubility product Ksp by conductivity method Part2: Determination of ΔG, ΔH and ΔS by solubility product method	**3**
Lab 08	Calculate the equilibrium constant electrochemically	**3**
Lab 09	Corrosion rate (weight loss), Corrosion Inhibition Corrosion rate (corrosion current)	**3**
Lab 10	Potentiometric Titration of a Bromide-Iodide Mixture	**3**
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 and Understanding**		
1.1	**To recognize some principles of electrochemistry.**	**Lecture**	**Short quizzes**
1.2	**To state Nernst equation for a galvanic cell potential due to change of redox system.**	**Lecture and laboratory experiments**	**Exams and lab reports**
1.3	**To memorize laws of conductivity, resistivity and related phenomena.**	**Group discussions and laboratory experiments**	**Oral test and lab reports**
1.4	**To define corrosion and its impact upon metal integrity, and list methods of corrosion prevention**	**Lecture, homework and laboratory experiments**	**Homework assignment marks and lab reports**
2.0	**Skills**		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.1	To measure electrochemical quantities using experimental data, and calculate calculate the membrane potential using Nernst equation.	Tutorials Lectures and laboratory experiments	Solved problem marks Short quizzes and Laboratory reports Numerical problem
2.2	To analyze data and results through analytical thinking, with evaluation of the gained information.	Tutorial, Brain storming and self-study	Work portfolio and homework
2.3	To demonstrate skills to participate in class by asking questions and giving answers.	Motivate students to ask questions and to give response.	Participation marks
2.4	To Demonstrate oral communication and technical writing skills through writing and oral presentation of mini reports, to diagram and illustrate experimentally obtained data during laboratory classes and to operate electronic mail and Network in communicating with others.	• Seminars • Group discussions and lab experiment • Group discussion and assignments • Encourage students to use electronic mail to submit works and assignements. • Virtual labs and demonstrations	• Presentation marks • Oral tests and lab sheets • Oral test and assignments marks • Assignments and homework • Laboratory performance • Laboratory reports and sheet
3.0	Values		
3.1	Appraise teamwork, decision-making in unpredictable work, and management of resources and time.	• Group discussions and lab experiment • Homework • Mini reports • Virtual labs and demonstrations	• Presentation marks. • Oral tests and lab sheets • Assessments and homework • Laboratory reports and sheet

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	10 %
2	Midterm 2	8th/9th weak	10%
3	Quizzes, Homeworks, class participation, and mini projects	During the semester	10 %
4	Laboratory	All the semester	30 %

#	Assessment task*	Week Due	Percentage of Total Assessment Score
5	Final Exam	10-11thweek	40 %
6	Total	All weeks	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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Analytical Electrochemistry***, Joseph Wang, 3rd Ed., 2006, John Wiley & Sons, New Jersy, ISBN: 978-0-471-67879-3.
Essential References Materials	• ***Electrochemical Methods: Fundamentals and Applications***, A. J. Bard and L. R. Faulkner, 2nd Ed., 2001, John Wiley & Sons, New York, ISBN: 0-471-04372-9.
Electronic Materials	• **Blackboard** • **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true** • **http://www.chem1.com/acad/webtext/virtualtextbook.html** • **http://www.shodor.org/UNChem/index.html**
Other Learning Materials	• **None**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each classroom is equipped with PC and retro projector with a maximum of 25 students.** • **Each Laboratory should be equipped with maximum 25 seats and suitable instruments.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or	**None**

Item	Resources
attach a list)	

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Chemistry of Colloids**
Course Code:	**CHM 345**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 4 (3 Lectures, 2 Lab and Tutorials)
2. Course type **a.** University ☐ College ☐ Department ✓ Others ☐ **b.** Required ☐ Elective ✓
3. Level/year at which this course is offered: Level 7 / Year 3
4. Pre-requisites for this course: Physical Chemistry (2) –CHM 242
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**	**50**	**100 %**
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**30**
2	**Laboratory/Studio**	**20**
3	**Tutorial**	**0**
4	**Others** (Mini-reports, Midterm, Final Exam)	**0**
	Total	**50**

B. Course Objectives and Learning Outcomes

1. Course Description

The course will give knowledge about Colloidal State of matter: Classification, preparation and physical properties, Electro kinetic phenomena; Colloidal electrolytes and their uses, Emulsion; preparation, properties, stability and use. Surface Chemistry: Solid surfaces and their characterization; Adsorption on solid surfaces: technique for measurement of adsorption from gas phase and solution; Langmuir, Freundlich and BET adsorption isotherm: Enthalpy of adsorption; Adsorption on liquid surface. Gibb's adsorption equation; Surface film; Electro-capillary phenomena.

2. Course Main Objective

At the end of the course, Students should be able:

- ***Describe the basic principles of colloids preparation, purification, theory of stability, instability and main types of stabilization.***
- ***Outline the electro-kinetic and optical properties of colloids.***
- ***Define surface chemistry and adsorption desorption process.***

- ***List techniques for measurement of adsorption from gas phase and solution.***
- ***Analyze data and results through analytical thinking, with evaluation of the gained information.***
- ***Operate laboratory instruments, and diagram and illustrate experimentally obtained data.***

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To memorize state, classification, and physical properties of colloids.**	**K1; K2; K3;**
1.2	**To describe the basic principles of colloids preparation, purification, theory of stability, instability and main types of stabilization.**	**K1; K2; K3**
1.3	**To outline the electro-kinetic and optical properties of colloids.**	**K1**
1.4	**To define surface chemistry and adsorption-desorption process, and list techniques for measurement of adsorption.**	**K1; K3**
2	**Skills :**	
2.1	**To calculate Adsorption parameters using problems and their solutions, and estimate kinetic, physical and optical parameters of colloidal systems.**	**S1; S2; S3**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S2; S3**
2.3	**To demonstrate skills to participate in class by asking questions and giving answers.**	**S3**
2.4	**To diagram and explain experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	**S2; S4**
3	**Values:**	
3.1	**To appraise coordination and raise knowledge during various evaluations, initiatives, and mini reports to uphold scientific integrity.**	**V1; V2**

C. Course Content

No	List of Topics	Contact Hours
1	History, component, dispersed phase, dispersion medium, micelles, aggregation, classification, Lyophilic , Lyophobic properties, Tyndall effect, Brownian movement, Zeta potential, electrophoresis. Preparation, dispersion method, Bredig's Electric Arc, mechanical dispersion, Ultrasonic Dispersion, peptization dispersion, Condensation or Aggregation Methods, Preparation of colloidal sol. Purification, Dialysis, Electrodialysis, Ultra-filtration, Ultra-centrifugation; Application and chemical impact, Colloid Chemistry .	**8**
2	Brownian motion, random walk, Brownian displacement equation, Diffusion, Fick's first law, diffusion coefficient, Einstein's equation. Sedimentation: driving force, liquid resistance, frictional coefficient, Stoke's law, sedimentation rate.	**6**

3	Ultracentrifuge, sedimentation-diffusion equilibrium, Charge effects. Colligative properties, Osmotic pressure, Van's Hoff's law The Donnan membrane effect, viscosity.	**4**
4	Light scattering: Tyndall effect, turbidity, size and shape, Debye scattering, Rayleigh Scattering, Molar Masses, Doppler Broadening. Ultramicroscope. micro electrophoresis. Electronmicroscope, the resolving power, the limit of resolution .	**4**
5	Theory of stability, instability, main types of stabilization, DLVO Theory, Electrostatic stability, Electric double layer, conditions for colloid stability, thermodynamic and kinetic aspects.	**8**
Total		**30**
Topics to be covered (Laboratories)		
Lab 01	Preparation of A hydrophobic colloidal sol: red color sol of Fe(OH)3 , Preparation of a colloidal solution (sol) of starch,	**3**
Lab 02	Emulsion and emulsifying agent, Rheological characterization of concentrated emulsions (creams),	**3**
Lab 03	Determination of the critical micelle concentration of SDS,	**3**
Lab 04	Measurement of surface tension of solutions by Du Nouy tensiometer,	**3**
Lab 05	Polymer's relative molecular masses from viscosity measurements,	
Lab 06	Determination of size distribution of a sedimenting suspension,	**3**
Lab 07	Zeta potential measurements of dyes by paper electrophoresis,	**3**
Lab 08	Study of adsorption of Methylene blue from solution on charcoal – Verification of Freundlich and Langmuir adsorption models,	**3**
Lab 09	Study of adsorption of acetic acid from solution on charcoal – Verification of Freundlich and Langmuir adsorption models,	**3**
Lab 10	Analysis of the experimental data obtained in Labs 7 and Lab 8, Review	**3**
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 and Understanding**		
1.1	**To memorize state, classification, and physical properties colloids.**	**Lecture**	**Short quizzes**
1.2	**To describe the basic principles of colloids preparation, purification,**	**Lecture and laboratory experiments**	**Exams and lab reports**

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	theory of stability, instability and main types of stabilization.		
1.3	To outline the electro-kinetic and optical properties of colloids.	Group discussions and laboratory experiments	Oral test and lab reports
1.4	To define surface chemistry and adsorption-desorption process, and list techniques for measurement of adsorption from gas phase and solution.	Lecture, homework and laboratory experiments	Homework assignment marks and lab reports
2.0	**Skills**		
2.1	To calculate Adsorption parameters using problems and their solutions, and estimate kinetic, physical and optical parameters of colloidal systems.	Tutorials Lectures and laboratory experiments	Solved problem marks Short quizzes and Laboratory reports Numerical problem
2.2	To analyze data and results through analytical thinking, with evaluation of the gained information.	Tutorial, Brain storming and self-study	Work portfolio and homework
2.3	To demonstrate skills to participate in class by asking questions and giving answers.	Motivate students to ask questions and to give response.	Participation marks
2.4	To diagram and explain experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.	• Seminars • Group discussions and lab experiment • Encourage students to use electronic mailand blackboard to submit works and assessments.	• Presentation marks • Oral tests and lab sheets • Assignments and homework • Laboratory performance • Laboratory reports and sheet
3.0	**Values**		
3.1	To appraise coordination and raise knowledge during various evaluations, initiatives, and mini reports to uphold scientific integrity.	• Group discussions • Homework • Mini reports • Virtual labs and demonstrations	• Presentation marks • Oral tests and lab sheets • Assessments and homework • Laboratory reports and sheet

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	10 %
2	Midterm 2	8th/9th weak	10%
3	Quizzes, Home Works, class participation, and mini projects	During the semester	10 %
4	Laboratory	All the semester	30 %
5	Final Exam	11-12thweek	40 %
6	Total	All weeks	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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Principle of Colloids and Surface Chemistry.*** Duncan J. Shaw, 4th Edition esc, PhD, FRS, Liverpool Polytechnic, (ISBN 07506 11820).
Essential References Materials	• ***Colloid Science: Principles, Methods and Applications*****,** Terence Cosgrove , Blackwell (2005). • ***Principle of Colloids and Surface Chemistry*****,** Hiemenz and Raj Rajagopala 3rd Edition, CRC (1997).
Electronic Materials	• **Blackboard** • **http://www.funsci.com/fun3_en/exper2/exper2.htm** • **http://www.kt.dtu.dk/english/Education/Continuing_education/Business/Colloid_and_surface_chemistry.**
Other Learning Materials	• **None**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each classroom is equipped with PC and retro projector with a maximum of 25 students.**

Item	Resources
	• **Each Laboratory should be equipped with maximum 25 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Quantum Chemistry**
Course Code:	**CHM 346**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 3 (3 Lectures, 0 Lab, 0 Tutorials)
2. Course type **a.** University ☐ College ☐ Department ✓ Others ☐ **b.** Required ✓ Elective ☐
3. Level/year at which this course is offered: Level 6 / Year 2
4. Pre-requisites for this course: MAT 103 – CHM 242
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	30	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	30
2	Laboratory/Studio	0
3	Tutorial	0
4	Others (Mini-reports, Midterm, Final Exam)	0
	Total	30

B. Course Objectives and Learning Outcomes

1. Course Description

This course deals with classical and quantum mechanics, black body radiation, atomic models and spectra, Schrodinger equation, operators, postulates of quantum mechanics, wave functions, particle in 1-D box, rigid rotor and harmonic oscillator.

2. Course Main Objective

At the end of the course, Students should be able:

- ***Describe the failure of classical mechanics in contrast to quantum mechanical phenomena.***
- ***Define concepts relevant to quantum mechanics such as photoelectric effect, wave-particle duality.***
- ***Recognize the principles of the translational motion, particle in a box.***
- ***Write the Schrodinger equation in its correct form.***
- ***Calculate the energies of atomic orbital for hydrogen and hydrogen-like atoms.***

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To describe the failure of classical mechanics in contrast to quantum mechanical phenomena.**	**K1; K2; K3;**
1.2	**To define concepts relevant to quantum mechanics such as photoelectric effect, wave-particle duality.**	**K1; K2; K3;**
1.3	**To recognize the principles of the translational motion, particle in a box.**	**K1**
1.4	**To outline the Structure and spectra of hydrogen atomic orbitals and energies of shells and sub shells.**	**K1; K3**
2	**Skills :**	
2.1	**To calculate Adsorption parameters using problems and their solutions, and estimate kinetic, physical and optical parameters of colloidal systems.**	**S1; S2; S3**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S2; S3**
2.3	**To demonstrate ability to do oral communication and technical writing skills through writing and oral presentation of mini-reports, operate electronic mail and Network in communicating with others.**	**S3**
3	**Values:**	
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	**V1, V2**

C. Course Content

No	List of Topics	Contact Hours
1	**Classical Mechanics**: dawn of quantum mechanics, Black-Body radiation, Photo electric effect, dual nature of light, the uncertainty principle, Bohr model of the atom, spectral series, Rydberg formula for hydrogen spectrum.	**8**
2	**Derivation of Schrodinger equation**: Operators and their properties, eigenfunctions and eigenvalues, postulates of quantum mechanics, Particle in 1-D box and Harmonic oscillator.	**10**
3	**Rigid-rotor model**: hydrogen atoms and hydrogen like atoms wave function, Normalized and orthogonal wave functions, translational motion. Classical and quantum mechanical treatment.	**12**
Total		**30**
Topics to be covered (Laboratories)		
None		

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**		
1.1	To describe the failure of classical mechanics in contrast to quantum mechanical phenomena.	Lecture	Short quizzes
1.2	To define concepts relevant to quantum mechanics such as photoelectric effect, wave-particle duality.	Lecture and group discussions	Oral tests and MCQs, Homework
1.3	To recognize the principles of the translational motion, particle in a box.	Lecture and group discussions	Short quizzes oral tests, Homework
1.4	To outline the Structure and spectra of hydrogen atomic orbitals and energies of shells and sub shells.	Lecture and group discussions	Oral tests and MCQs
2.0	**Skills**		
2.1	To write the Schrodinger equation in its correct form and develop means of solving wave function equations.	Lecture and oral discussions	Solved problem marks Short quizzes and homework assignment
2.2	To analyze data and results through analytical thinking, with evaluation of the gained information.	Tutorial, Brain storming and self-study	Work portfolio and homework
2.3	To demonstrate skills to participate in class by asking questions and giving answers.	Motivate students to ask questions and to give response.	Participation marks
3.0	**Values**		
3.1	To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.	• Seminars • Group discussion and assignments • Homeworks • Mini reports	• Presentation marks • Oral tests • Assignments and homeworks • Mini reports assignment

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	20 %
	Midterm 2	8th/9th weak	20%

#	Assessment task*	Week Due	Percentage of Total Assessment Score
3	Quizzes, Home Works, class participation, and mini projects	During the semester	20 %
4	Final Exam	11-12thweek	40 %
5	Total	All weeks	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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Physical Chemistry,*** Atkins, P. W., and J. de Paula. 8th ed. 2001, Freeman and Company, New York, NY: W.H. (ISBN: 9780716735397)
Essential References Materials	• ***Physical Chemistry*****,** Sanctuary, K. J. Laidler, J. H. Meiser, B. C., 4th Ed 2003, Houghton Mifflin CompanyISBN: 81-239-0645-5. • ***Physical Chemistry*****.** Silbey, R., R. Alberty, and M. Bawendi. 4th ed, 2004,: John Wiley & Sons, New York, NY. ISBN: 9780471215042
Electronic Materials	• **Blackboard** • **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true** • **http://www.chem1.com/acad/webtext/virtualtextbook.html** • **http://www.shodor.org/UNChem/index.html**
Other Learning Materials	• **None**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each classroom is equipped with PC and retro projector with a maximum of 25 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources	**None**

Item	Resources
(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	

G. Course Quality Evaluation

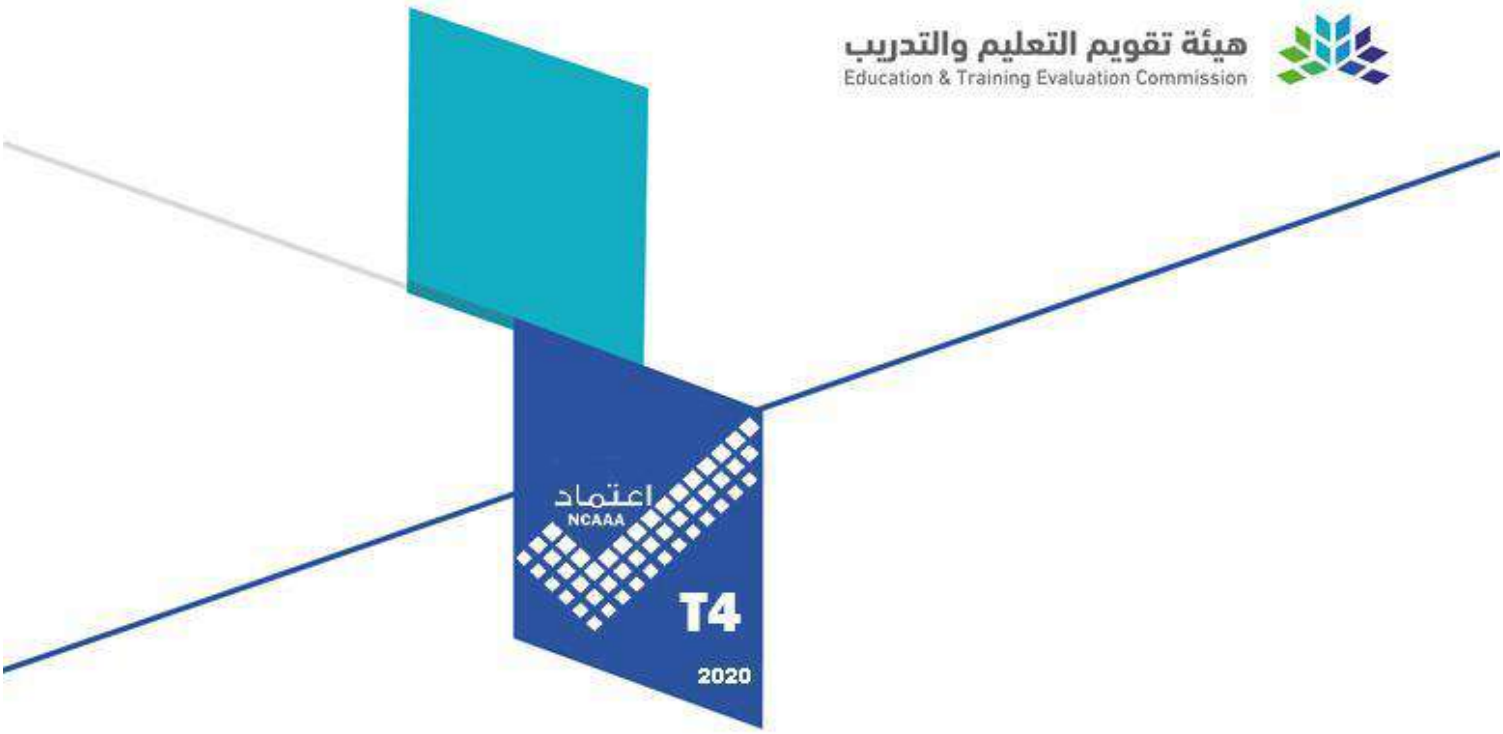
Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.

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	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Selected Course (2)**
Course Code:	**CHM 414**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

A. Table of Contents

B. Course Identification

1. Credit hours: 3(2 Lectures, 2 Lab, 0 Tutorial)
2. Course type **a.** University ☐ College ☐ Department ☐ Others ☐ **b.** Required ☐ Elective ☐
3. Level/year at which this course is offered: Level 8/Year 3
4. Pre-requisites for this course (if any)**: According to selected course**
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**	**40**	**100%**
2	**Blended**		
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**20**
2	**Laboratory/Studio**	**20**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**40**

C. Course Objectives and Learning Outcomes

1. Course Description:

Topics covered in the course include the introduction on the water and the methods of water treatment. The course will be provide the students with Basic information for Nitrogen, Phosphorus, and Potash, Nitrogen-Containing Fertilizers, Sulfur and Sulfur Compounds, Alkalis and Related products and the halogens. It gives also information on ceramics, classification of ceramics and ceramic manufacturing processes glass, composition of glass and manufacturing procedure. It provides information on extractive metallurgy.

2. Course Main Objective: ***This course is entended:***

- To improve the student's knowledge of the basic information for industrial requirements and methods of preparation.
- To develop awareness on the contributions of chemistry to society.
- To develop awareness on the range and scope of the Saudi chemical industry.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recognize the basic information of inorganic industrial chemistry.**	**K1, K3**
1.2	**To list the methods of preparation of most important inorganic compounds in industries and to identify a number of industrial and metallurgical processes for the separation, preparation or synthesis of elements and inorganic compounds.**	**K1, K2, K3**
1.3	**To name environmentally harmful substances and materials.**	**K1, K2**
2	**Skills :**	
2.1	**To differentiate between different industries using inorganic compounds.**	**S2, S3**
2.2	**To explain methods of preparation of industrial inorganic commodities and to evaluate the wastes of water by different treatment methods.**	**S1, S2, C3**
2.3	**To write correct equation for the different industrial compounds synthesis.**	**S1, S3**
2.4	**To demonstrate effective written and oral communication skills, especially the ability to transmit complex technical information in a clear and concise manner and operate electronic mail and Network skills in communicating with others and in submitting homework and assignments.**	**S1, S2, S3, S4**
3	**Values:**	
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	**V1;V2**

D. Course Content

No	List of Topics	Contact Hours
	Topics to be covered (Lectures and Tutorial)	
1	Primary Inorganic Materials Water: Economic Importance, Production of Potable Water, Filtration, Production of Soft or Deionized Water, Water Hardness and its treatment Hydrogen: Economic Importance, Hydrogen peroxide preparations Nitrogen and Nitrogen Compounds: Conversion of Synthesis Gas to Ammonia, Integrated Ammonia Synthesis Plants, Economic Importance and Applications, Manufacture of Highly Concentrated Nitric Acid Urea Process, Applications of Hydrazine Phosphorus and its Compounds, Phosphorus and Inorganic Phosphorus Compounds, Products, Phosphoric Acid, Phosphoric Acid Salts, Phosphorus. Sulfur and Sulfur Compounds: Sulfur, Economic Importance, Applications, Sulfuric Acid, Starting Materials for Sulfuric Acid Manufacture, Sulfuric Acid from Sulfur Dioxide Potassium-Containing Fertilizers: Occurrence of Potassium Salts, Economic Importance of Potassium-Containing Fertilizers, Manufacture of Potassium-Containing Fertilizers	5
2	Mineral Fertilizers Nitrogen-Containing Fertilizers: Economic Importance, General Information Importance of Ammonium Sulfate, Importance of Ammonium Nitrate, Importance of Urea, Manufacture of Nitrogen-Containing Fertilizers	5

	N-P-K fertilizer: sources and forms of fertilizers	
3	Metal Halide Chloro-alkali metal: MANUFACTURE OF CHLORINE–CAUSTIC SODA USING ELECTROLYSIS PROCESS, PROPERTIES OF CHLORINE-CAUSTIC SODA-HYROGEN, The Diaphragm cell process, The Mercury cell process	5
4	Review	**5**
Topics to be covered (Laboratories)		
1	Laboratory safety, introduction and how to make a report & Determination of water hardness	**2**
2	Determination of nitrogen in ammonium nitrate & Determination of nitrogen in Urea	**2**
3	Determination of phosphorous	**2**
4	Determination of potassium	**2**
5	Determination of water in fertilizer	**2**
6	Determination of sulphur	**2**
7	Determination of chloride	**2**
8	Soap Creation (hot method) & Soap Creation (cold method)	**2**
9	Introduction to N-P-K fertilizer	**2**
10	Manufacture and analysis of bench scale N-P-K fertilizer	**2**
Total		**40**

E. 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**		
1.1	**To recognize the basic information of inorganic industrial chemistry.**	Oral Discussion MCQs, Quizzes marks.	Short quizzes
1.2	**To list the methods of preparation of most important inorganic compounds in industries and to identify a number of industrial and metallurgical processes for the separation, preparation or synthesis of elements and inorganic compounds.**	Midterms. Assignments	Homework and assignment marks and written exams
1.3	**To name environmentally harmful substances and materials.**	Final exam.	Quizzes and MCQs, laboratory report
2.0	**Skills**		
2.1	**To differentiate between different industries using inorganic compounds.**	Short Quizzes and Exams.	Short quizzes and Multiples Choice Questions
2.2	**To explain methods of preparation of industrial inorganic commodities and to**	Questions in Lectures.	Homework assignment, Examination and laboratory sheet

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	evaluate the wastes of water by different treatment methods.		
2.3	**To write correct equation for the different industrial compounds synthesis.**	Short Quizzes and Exams. Oral Presentation	Examination and laboratory report
2.4	**To demonstrate effective written and oral communication skills, especially the ability to transmit complex technical information in a clear and concise manner and operate electronic mail and Network skills in communicating with others and in submitting homework and assignments.**	Oral tests and assignments marks homework	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks
3.0	**Values**		
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	Oral presentation, Assessments and homework marks	• Oral tests, lab performance, Lab-reports and sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Homework**	**All the semester**	**10 %**
2	**Laboratory**	**All the semester**	**30 %**
3	**Midterm Exam 1**	**Around 5th week**	**10 %**
4	**Midterm Exam 2**	**Around 8th week**	**10%**
5	**Final Exam**	**Around 11th– 12thweek**	**40 %**
6	**Total**		**100%**

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

F. Student Academic Counseling and Support

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

- **There are 2 office hours per week reserved by each staff member, planned on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counselling.**

G. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	• Karl H. Buchel, Hans H. Moretto and Peter Woditsch, Industrial Inorganic Chemistry, 2nd Ed. WILEY-VCH Verlag CmbH. D-69469 Weinheim (Federal Republic of Germany), 2000 ,(ISBN: 3-527-29849-5)
Essential References Materials	• Karl H. Buchel, Hans H. Moretto and Peter Woditsch, Industrial Inorganic Chemistry, 2nd Ed. WILEY-VCH Verlag CmbH. D-69469 Weinheim (Federal Republic of Germany), 2000 ,(ISBN: 3-527-29849-5) • O.P. Vermani, A.K. Narula, Applied Chemistry, Theory and Practice, SECOND EDITION, 1995, New Age International (P) Ltd., Publishers Published by New Age International (P) Ltd., Publishers, ISBN (13) : 978-81-224-2494-2 • Robert H. Crabtree, The organometallic chemistry of the transition metals, , 4th, Yale University, New Haven, Connecticut,A John Wiley & Sons, Inc., Publication 2005 ,10 9 8 7 6 5 4 3 2 1.
Electronic Materials	• Blackboard • Internal server: http://www.chemistrylecturenotes.com/html/electrochemistry.html
Other Learning Materials	**Non**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

H. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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)

I. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Nuclear and Radiation chemistry**
Course Code:	**CHM 415**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 3 (3 Lectures, 0 Lab, 0Tutorials)
2. Course type **a.** University ☐ College ☐ Department ✓ Others ☐ **b.** Required ☐ Elective ✓
3. Level/year at which this course is offered: Level 7 / Year 3
4. Pre-requisites for this course: Inorganic Chemistry (2) / CHM 212
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	30	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	30
2	Laboratory/Studio	0
3	Tutorial	0
4	Others (Mini-reports, Midterm, Final Exam)	0
	Total	30

B. Course Objectives and Learning Outcomes

1. Course Description

The course covers the following topics: introduction to nuclear chemistry, types of radiations, nuclear reactions, kinetics of nuclear decay, half-life, reactors, radiation detection, isotope separation and applications.

2. Course Main Objective

Students should be able to:

- **Improve their knowledge of the basic information of Radiation and Nuclear chemistry; requirements, methods of preparation, uses of Radioelements.**
- **Be aware of the contributions of chemistry to society**
- **Improve their knowledge of types of radioactive decay, natural decay series, nuclear models, nuclear properties, Mass energy, relationships, nuclear reactions, rates of radioactive decay, interaction of radiation with matter.**
- **Improve their knowledge of instrumentation and Introduction to health – physical applications in nuclear and radiochemistry.**

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recognize the basic information of radioactive and nuclear chemistry and to identify instrumentation and health applications in nuclear and radiochemistry.**	**K1, K2, K3**
1.2	**To list types of radioactive decay, natural decay series, nuclear models, nuclear properties, Mass energy.**	**K1, K3**
1.3	**To identify environmentally harmful nuclear materials and name some applications of radio-isotopes.**	**K1, K3**
2	**Skills :**	
2.1	**To differentiate between the different types of radioactive decay and predict nuclides stability and nuclear reaction products.**	**S2, S3**
2.2	**To calculate the mass defect and binding energy for fission and fusion reaction.**	**S1, S2**
2.3	**To estimate ages of materials using carbon and uranium dating.**	**S1, S2**
2.4	**To write topics related to subject using different educational resources, to demonstrate effective written and oral communication skills. to illustrate the ability to present data in graphs to derive variables and to operate electronic mail and Network skills in communicating with others**	**S1, S3**
3	**Values:**	
3.1	**To appraise teamwork and create awareness to maintain scientific integrity during different assessments, projects, and mini-reports. To use different educational sources to understand the topic, to demonstrate self-learning responsibility,**	**V1, V2**

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction:** Nuclear Chemistry, radioactivity. Comparison among α, β, and γ Rays, Electron Capture, Nuclear Stability, Predicting Type of Decay	**2**
2	**The Kinetics of Radioactive Decay:** Radioactive decay, Variation of radioactivity over time, Units of measurement for radioactivity, Plotting radioactive decay, Radioactive equilibrium, Transient radioactive equilibrium, Radioactive disintegration series, Artificial radioactivity	**4**
3	**Mass Defect and Binding Energy:** Mass defect, Mass-energy equivalence, Binding energy, Binding energy per nucleon, Nuclear fission, Energy released in a fission reaction, Liquid drop model of a nucleus, Nuclear fusion.	**4**
4	**Nuclear Reactors:** Nuclear reactors, Types of fuel, Reactor core, Reflector, Moderator, Coolants, Shielding, Breeder reactor.	**2**
5	**Reactor Theory and Neutron Interactions:** Scattering, Inelastic scattering, Absorption reactions, Radiative capture, Particle ejection, Neutron characteristics, Neutron sources, Nuclear cross sections and neutron flux, Atom density, Cross sections, Mean free path, Calculation of macroscopic cross section and mean free path, Effects of	**6**

	temperature on cross section, Neutron flux, Reactor power calculation, Relationship between neutron flux and reactor power, Neutron slowing down and thermalization, Neutron flux spectrum, Most probable neutron velocities.	
6	**Radiation Detectors:** Gas counters, Neutron detectors, Scintillation counters, Solid state detectors, Statistics of counting, Pulse height analysis, Advanced detectors	**2**
7	**Isotope separation:** Uranium enrichment, Separation technologies, Mass spectrograph, Gaseous Diffusion Separator, Gas Centrifuge, Laser Isotope Separation, Nozzle process, Helikon process, Thermal diffusion, Chemical exchange, Distillation, Separation of Deuterium by Electrolysis.	**4**
8	**Applications of Radioisotopes:** Photosynthesis in plants, Agriculture Industry, Research, Biological research, Isotopic dating in Geology, Radio-carbon dating technique, Trace analysis of elements and compounds - neutron activation analysis, isotope dilution analysis.	**6**
Total		**30**
Topics to be covered (Laboratories)		
None		

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**		
1.1	**To recognize the basic information of radioactive and nuclear chemistry and to identify instrumentation and health applications in nuclear and radiochemistry.**	**Lecture**	**Short quizzes**
1.2	**To list types of radioactive decay, natural decay series, nuclear models, nuclear properties, Mass energy.**	**Lecture and group discussions**	**Oral tests and MCQs, Homework**
1.3	**To identify environmentally harmful nuclear materials and name some applications of radio-isotopes.**	**Lecture and group discussions**	**Short quizzes oral tests, Homework**
2.0	**Skills**		
2.1	**To differentiate between the different types of radioactive decay and predict nuclides stability and nuclear reaction products.**	• **Group discussion** **Lectures**	• **Exams** **Quizzes**
2.2	**To calculate the mass defect and binding energy for fission and fusion reaction.**	**Group discussion and pair thinking**	**Oral tests and homework**
2.3	**To estimate ages of materials using carbon and uranium dating.**	**Self-study**	**Assay marks**

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.4	To write topics related to subject using different educational resources, to demonstrate effective written and oral communication skills. to illustrate the ability to present data in graphs to derive variables and to operate electronic mail and Network skills in communicating with others	• Seminars • Group discussion and assignments Encourage students to use electronic mail to submit homework and assignments.	• Oral tests and presentation marks • Assignments and homework marks Group competitions
3.0	**Values**		
3.1	To appraise teamwork and create awareness to maintain scientific integrity during different assessments, projects, and mini-reports. To use different educational sources to understand the topic, to demonstrate self-learning responsibility,	• Group discussions and assignment. • Homework • Mini-reports	• Oral presentation marks. • Assessments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	20 %
2	Midterm 2	8th/9th weak	20%
3	Quizzes, Homeworks, class participation, and mini projects	During the semester	20 %
4	Final Exam	10-11thweek	40 %
5	Total	All weeks	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 :

- There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.
- Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• *Modern Nuclear Chemistry, Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg 2nd Ed. (2017), Wiley, ISBN: 978-0-471-11532-8.*

Essential References Materials	• ***Atoms, Radiation, and Radiation Protection***, James E. Turner, 3rd Ed. (2007) WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, ISBN 978-3-527-40606-7..
Electronic Materials	▪ **Blackboard** ▪ **http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true** ▪ **http://www.chem1.com/acad/webtext/virtualtextbook.html** ▪ **http://www.shodor.org/UNChem/index.html**
Other Learning Materials	**Comprehensive Inorganic Chemistry**. Sulekh Chandra, New Age International Limited Publishers, New Delhi, 2004 Descriptive inorganic chemistry, Rayner-Canham, Geoff., Publisher: W.H. Freeman, New York, 2006

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each classroom is equipped with PC and retro projector with a maximum of 25 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations-

Evaluation Areas/Issues	Evaluators	Evaluation Methods
		Syllabus review- Accreditation review.
	Course Responsible	

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	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Selected Course (3)**
Course Code:	**CHM 416**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

A. Table of Contents

B. Course Identification

1. Credit hours:	**3(2 Lectures, 2 Lab, 0 Tutorial)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 9/Year 3**
4. Pre-requisites for this course (if any)**:**	**According to selected course**
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	40	100%
2	Blended		
3	E-learning		
4	Correspondence		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	20
2	Laboratory/Studio	20
3	Tutorial	0
4	Others (specify)	0
	Total	40

C. Course Objectives and Learning Outcomes

1. Course Description:

Topics covered in the course include the introduction on the Ceramics, in terms of classification, the raw materials, and advanced process in the ceramic industries. The course will extend the Cement industry, Glasses and the Manufacturing procedure. Metallurgical Processes and Metals is one of the topics that will cover in this course.

2. Course Main Objective: ***This course is entended:***

- To enrich the student's knowledge of the basic information for industrial requirements and methods of preparation relevant to inorganic chemistry industries.
- To develop awareness on the contributions of chemistry to industry KSA.
- To disclose on the range and scope of the Saudi chemical industry relevant to provision of Silicate products, construction materials, oxide ceramics, and related industries

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recognize the basic information of inorganic industrial chemistry.**	**K1, K3**
1.2	**To list and to state types of ceramics, glass, cements and metallurgy**	**K1, K2, K3**
1.3	**To outline environmentally harmful substances and materials.**	**K1, K2**
2	**Skills :**	
2.1	**To differentiate between different industries using inorganic compounds and explain methods of preparation of industrial inorganic commodities.**	**S1, S2, C3**
2.2	**To write correct equation for the different industrial compounds synthesis.**	**S1, S3, C1**
2.3	**To evaluate the wastes of water by different treatment methods.**	**S1, S3, C1**
2.4	**To diagram and illustrate experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	**S1,S2, S3, S4**
3	**Values:**	
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	**V1;V2**

D. Course Content

No	List of Topics	Contact Hours
	Topics to be covered (Lectures and Tutorial)	
1	**Ceramics:** Ceramics, Classification of Ceramics, Traditional Ceramics, Advanced Ceramics, Ceramics Raw Materials, Naturally occurring minerals, Silicate Raw Materials, Non-Silicate Raw Materials, Synthetic Materials, Ceramic Manufacturing Processes, Traditional Processes, Body Formation, Drying and Firing, Advanced Processes, Gas-Phase Reactions, Deposition (CVD):Chemical Vapor, Liquid Precursor Methods, Homogeneous- and Co-precipitation, Polymer Pyrolysis, Sol-Gel Process, Powder Precursor Methods, Fusion Casting, Sintering.	5
2	**Cement**: Cement, Nonhydraulic Cements, Hydraulic Cements, Portland Cement, Manufacturing Process, Dry process, Wet process, Burning Operation, Clinker Cooling and Grinding with Gypsum, Lime saturation factor, silica ratio and alumina ratio, Hydration of Portland Cement, Mechanism of Hydration, Through-solution hydration, Topochemical or solid state hydration, Hydration of tricalcium aluminate, Hydration of Silicates, The stoichiometric reactions for fully hydrated C3S and β-C2S, Schematic description of hydration and structure devolved in the cement paste, Types of Portland Cement, Factors Affecting the Rate of Hydration, Chemical and Sulphate Attack	5
3	**GLASS**: Glasses, Composition of glass, Different varieties of glass, Vitreous Silica, Alkali silicates Lime glass, Potash lime glass, Lead glass, Borosilicate glass, Special glasses, Coloured glasses Opal, translucent, Safety or laminated glass, Fibre glass, Phosphate glass, High silica glass, Properties of glass, Physical, Chemical, different constituents of glass, Glass Raw materials, Chemical reactions of the formation, Manufacturing procedure.	5
4	**Metallurgical Processes and Metals:** Metallurgy of metals, Occurrence of metals, Some minerals of common metal, The main steps for the extraction of metals, Crushing and grinding, Concentration of the ore, Calcination/Roasting, Reduction, Purification, Chemical method, Smelting method, Electrolytic reduction, Reduction	**5**

	by precipitation, Alumino-thermic reduction, Refining of curde metals, Liquation, Poling, Distillation, Electrolytic refining, Cupellation. Copper, Occurrence, Extraction, Concentration by "froth flotation process, Smelting, Bessemerization, Refining, Poling, Electro-refining, Properties, Uses of Copper. Aluminium, Occurrence, Extraction, Baeyers process, Serpeck's process, Redaction (Hall-Heroult's Process), Purification of Aluminium (Hoop' s Process), Properties, Uses. Chromium, Occurrence, Extraction, Concentration, Roasting, Reduction of the dichromate to Cr2O3, Reductions Cr2O3 to Cr, Uses, Ferrochrome, Chrome-plating, Important chromium alloy steels. Lead, Occurrence, Extraction, Concentration, Redaction, Air-reduction method, Carbon-reduction process, Refining of lead, Fire–refining, Parke's desilverization process, Bett's electrolytic method, Properties, Uses.	
Topics to be covered (Laboratories)		
1	Safety and Laboratory equipment and measurements and How to make a report & Introduction: Analysis of calcium Carbonate Minerals	**2**
2	Analysis of calcium Carbonate Minerals: Determination of the percentage of loss on ignition	**2**
3	Determination of the Impure silica or acid insoluble matter	**2**
4	Determination of the amount of combined oxides impurities in carbonate ore	**2**
5	Determination of the amount of calcium in limestone	**2**
6	Determination of the water contents in cements: Determination of total water content, (Wt)	**2**
7	Determination of chemically combined water, (Wn): & Determination of Free water, (We):	**2**
8	Determination of available lime or free CaO in Cement	**2**
9	Preparation of glass and coloured glass & Colouring of glass sheet	**2**
10	Characterization and physical properties of glass & Determination of the durability of glass	**2**
Total		**40**

E. 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**		
1.1	**To recognize the basic information of inorganic industrial chemistry.**	Lecturing	Short quizzes
1.2	**To list and to state types of ceramics, glass, cements and metallurgy**	Solving problems, Homework and assignment	Homework and assignment marks and written exams
1.3	**To outline environmentally harmful substances and materials.**	Discussions, Laboratory classes	Quizzes and MCQs, laboratory report
2.0	**Skills**		
2.1	**To differentiate between different industries using inorganic compounds and explain methods of preparation of industrial inorganic commodities.**	Lecturing and oral discussion	Short quizzes and Multiples Choice Questions

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.2	**To write correct equation for the different industrial compounds synthesis.**	Lectures supported by laboratory experiments	Homework assignment, Examination and laboratory sheet
2.3	**To evaluate the wastes of water by different treatment methods.**	Lecturing and oral discussion supported by laboratory experiments	Examination and laboratory report
2.4	**To diagram and illustrate experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	• Oral participation • Group discussions and lab experiment and reports • Encourage students to use electronic mail to submit homework and assignments.	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks
3.0	**Values**		
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	• Group discussion, assignments and homework • Lab-reports • Virtual labs and demonstrations	• Oral tests, lab performance, Lab-reports and sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Homeworks**	**All the semester**	**10 %**
2	**Laboratory**	**All the semester**	**30 %**
3	**Midterm Exam 1**	**Around 5th week**	**10 %**
4	**Midterm Exam 2**	**Around 8th week**	**10%**
5	**Final Exam**	**Around 11th– 12thweek**	**40 %**
6	**Total**		**100%**

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

F. Student Academic Counseling and Support

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

- **There are 2 office hours per week reserved by each staff member, planned on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counselling.**

G. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	• Industrial Inorganic Chemistry , Karl H. Buchel, Hans H. Moretto and Peter Woditsch, , 2nd Ed. WILEY-VCH Verlag, CmbH. D-69469 Weinheim (Federal Republic of Germany), 2000 ,(ISBN: 3-527-29849-5
Essential References Materials	• Applied Chemistry, Theory and Practice, O.P. Vermani, A.K. Narula, 2nd ed., 1995, New Age International (P) Ltd., Publishers Published by New Age International (P) Ltd., Publishers, ISBN (13) : 978-81-224-2494-2
Electronic Materials	• Blackboard • http://www.chemistrylecturenotes.com/html/electrochemistry.html
Other Learning Materials	**Non**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

H. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
		Indirect: Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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)

I. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Polymers and Petrochemicals**
Course Code:	**CHM 428**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**2 (2 Lectures, 0 Lab, 0 Tutorials)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 9 / Year 3**
4. Pre-requisites for this course (if any)**:**	**Heterocyclic Chemistry- CHM 325**
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**	**20**	**100 %**
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**20**
2	**Laboratory/Studio**	**0**
3	**Tutorial**	**0**
4	**Others** (specify)	**0**
	Total	**20**

B. Course Objectives and Learning Outcomes

1. Course Description

This course provides students with an introduction to Polymers Chemistry and Petrochemicals, methods of preparation, physical properties and application as well extended to Petrochemicals Process and Chemistry.

Topics covered in the course include An Introduction to Polymer Chemistry, main synthetic methods including mechanism of Polymer, Reactions of Polymers, Distillation, Application in Petroleum Chemistry and Petrochemical Process.

2. Course Main Objective

At the end of this course the student will be able to:

- **Know the fundamentals of Polymer's Chemistry and Petrochemicals**
- **Understand the importance of the subject to pursue their career in academia or industry.**
- **Describe the physical properties of different polymers will be one of the outcome, and combination with industrial process.**

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recognize the basic concepts of Polymer Chemistry.**	**K1; K3;**
1.2	**To outline Polymers types Chemically, physically and of Polymerization Process.**	**K1; K3; S2;**
1.3	**To describe the Petrochemical Process in Petroleum Chemistry**	**K3;S1**
2	**Skills:**	
2.1	**To explain Polymerization Mechanisms and Petrochemical Separation Methods.**	**K1; K3; S1; S3**
2.2	**To summarize the Polymerization Process according to their physical properties required.**	**S1; S3**
2.3	**To plan multistep Synthesis of Polymer to improve its conversion percent.**	**S1; S3**
2.4	**To demonstrate Oral Communication to outline Polymers types, Polymerization Process, and the Petrochemical Process in Petroleum Chemistry orally and mentally, with improving technical writing skills through writing of mini- Reports, with operating electronic mail and Network in communicating with others.**	**S2, S3**
3	**Values:**	
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	**V1; V2**

C. Course Content

No	List of Topics	Contact Hours
1	**An Introduction to Polymer Chemistry:** Types of Polymers and Polymerizations, Nomenclature of Polymers, Linear, Branched, and Crosslinked Polymers, Molecular Weight, Physical State, Applications of Polymers	**3**
2	**Step Polymerization (Condensation Polymerization):** Reactivity of Functional Groups, Step Polymerizations Other than Polyesterification, Catalyzed versus Uncatalyzed, Molecular Weight Control in Linear Polymerization, Molecular Weight Distribution in Linear Polymerization , Process Conditions, Multi chain Polymerization, Crosslinking, Molecular Weight Distributions in Nonlinear Polymerizations, Crosslinking Technology, Polyesters, Unsaturated Polyesters, and Alkyds, Phenolic Polymers, Amino Plastics, Epoxy Resins, Polyurethanes, Step Copolymerization, Types of Copolymers, Methods of Synthesizing Copolymers, Block Copolymers, Utility of Copolymerization, High-Performance Polymers, Enzymatic Polymerizations	**7**
3	**Radical Chain Polymerization:** Nature of Radical Chain Polymerization, Structural Arrangement of Monomer Units, Experimental Determination of Rp, Initiation, Thermal Decomposition of Initiators, Redox Initiation, Molecular Weight, Chain Transfer, Inhibition and Retardation, Rate of Polymerization, Degree of Polymerization, Auto acceleration, Course of Polymerization, Molecular Weight Distribution, Polyethylene, Polystyrene,	**4**

	Vinyl Family, Poly(vinyl chloride), Polymerization of Dienes	
4	**Reactions of Polymers:** Other Reactions, Graft Copolymers, Radical Graft Polymerization, Vinyl Macro monomers, Chain Transfer and Copolymerization, Ionizing Radiation, Redox Initiation, Living Radical Polymerization, Anionic Graft Polymerization, Cationic Graft Polymerization, Other Approaches to Graft Copolymers, Block Copolymers	**3**
5	**Distillation, Application in PetroChemistry and Petrochemical Process:** Distillation and Distillation Categories, Processing Mode, Processing Sequence, System Types, Reactions, How Oil Formed, Oil Refining, Oil Production, Oil Process, Chemistry of Petrochemical Process	**3**
Total		**20**

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1	**Knowledge and Understanding**		
1.1	**To recognize the basic concepts of Polymer Chemistry.**	• Lectures and Group Discussion • A Private study including home exam.	• Quizzes • Discussion • Participation
1.2	**To outline Polymers types Chemically, physically and of Polymerization Process.**	• Lectures with group discussion. • Think, talk and discuss about Polymers types, Polymerization and Reactions process.	• Oral Discussion marks
1.3	**To describe the Petrochemical Process in Petroleum Chemistry**	• Lectures with group discussion. • Think, talk discuss about Petrochemical Process in Petrochemicals and industry	• Quizzes • Home exam • Oral discussions.
2	**Skills:**		
2.1	**To explain Polymerization Mechanisms and Petrochemical Separation Methods.**	▪ Lectures activity ▪ Think and talk about the reactivity of heterocyclic Compounds	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Participation ▪ Oral Discussion, • Laboratory Reports • Home Exam.
2.2	**To summarize the Polymerization Process according to their physical properties required.**	• Encourage students to communicate their logic chemical thinking, and to work and discuss cooperatively with	• Short Quizzes and Exams. • Oral Discussion

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
		their peers to develop individual skills.	
2.3	**To plan multistep Synthesis of Polymer to improve its conversion percent.**	• Lectures and Oral Discussions. • Brain storming Exercises	• Questions in Lectures. • Short Quizzes and Exams.
2.4	**To demonstrate Oral Communication to outline Polymers types, Polymerization Process, and the Petrochemical Process in Petroleum Chemistry orally and mentally, with improving technical writing skills through writing of mini- Reports, with operating electronic mail and Network in communicating with others.**	• Group Discussion and Assignments • Introduce several reports in Polymers and petrochemicals which will require reading, writing, and oral presentation • Encourage students to use electronic mail to submit Home Exams and Assignments	• Oral Discussion, Quizzes, and Exams. • Giving marks for Oral Discussion in Lectures. • Marks given for Assignments
3	**Values:**		
3.1	**To demonstrate responsibility for their own learning and motivate for Team Work.**	• Brain Storms Exercises • Group Discussion	• Oral Discussion. • Group Discussion and Assignments

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Home Exams**	**All the semester**	**20 %**
2	**Midterm Exam 1**	**Around 5th week**	**20 %**
3	**Midterm Exam 2**	**Around 8th week**	**20 %**
4	**Final Exam**	**Around 11th– 12th week**	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	***Principles of Polymerization , George Odian, John Wiley and sons Inc. Wiley Interscience, 4 th Edition, 2004. ISBN 0-471-27400-3.***
Essential References Materials	• ***Textbook of Polymer Science, Fred W. Billmeyer, Wiley-Interscience, 3rded, 1984, , ISBN: 978-0-471-03196-3*** • ***Polymer Science and Technology, Joel R. Fried, Prentice-Hall , 2nd ed., 2003, ISBN-10: 0137039557***
Electronic Materials	• **Blackboard** • **http://www.sigmaldrich.com**
Other Learning Materials	None

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Carbohydrates Chemistry and Natural Products**
Course Code:	**CHM 429**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**4 (2 Lectures, 3 Lab, 1 Tutorials)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 9 / Year 3**
4. Pre-requisites for this course (if any)**:**	**Organic Reaction Mechanism - CHM 327**
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	60	100%
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	20
2	Laboratory/Studio	30
3	Tutorial	10
4	Others (specify)	0
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

The course covers introduction to natural product chemistry; classification of natural products, isolation techniques and physiochemical data, the acetate pathway (fatty acids and polyketides), the shikimate pathway (aromatic amino acids and phenylpropanoids), the mevalonate (terpenoid and steroids), alkaloids, peptides and amino acid derivatives, and carbohydrates.

2. Course Main Objective

At the end of this course the student will be able to:

- **To recall functional groups of organic chemistry and their importance in the biosynthesis.**
- **To recognize the structure and molecular classification of a representative number of compounds belonging to the main classes of natural products.**

- **To list relevance of selected natural compounds and some chemical elaboration.**
- **To describe natural compounds and their tasks in nature.**
- **To outline the structure activity relationship of natural products.**

3. Course Learning Outcomes

	CLOs	AlignedPLOs
1	**Knowledge and Understanding**	
1.1	**To recall functional groups of organic chemistry and their importance in the biosynthesis.**	**K1; K3;**
1.2	**To recognize the structure and molecular classification of a representative number of compounds belonging to the main classes of natural products.**	**K1; K3; S2**
1.3	**To list relevance of selected natural compounds and some chemical elaboration and outline the structure activity relationship.**	**K3; S1**
2	**Skills:**	
2.1	**To explain different synthetic strategies pathways in natural products biosynthesis**	**K1, K3, S1, S2**
2.2	**To predict the bioactivity, properties and chemical structure of some natural products.**	**S1, S2, S3**
2.3	**To summarize different situations and problems in isolation of specific natural products group**	**S1, S3**
2.4	**Operate laboratory instruments and perform chemical experiments during laboratory classes and field tasks.**	**S1; S3; S4**
3	**Values:**	
3.1	**Maintain intellectual and scientific integrity during assignments, projects, and reports**	**V1; V2**

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction:** Occurrence, origin, main groups of natural products, impact of natural products in medicine.	**2**
2	**Alkaloides:** Introduction, Hagnauer system of classification, Physicochemical properties of alkaloids, Structural elucidation of alkaloids, Methods of isolation, Exaples of alkaloids and their application on medicine, Survey of known alkaloids, Biochemistry of alkaloids, Biosynthesis of alkaloids with examples for the formation.	**4**
3	**Terpenes and Terpinoids:** Introduction, Isoprene rule, Carbon-carbon bond formation in terpene biosynthesis, Classifiaction of Terpenes, Heme Biosynthesis, Chlorophyll biosynthesis, some examples of terpenes synthesis.	**4**
4	**Flavonides:** Purpose and delivery of flavonides in plants, Types of flavonides, Flavonides biosynthesis, Chemical analysis of flavonides, Legnin, Complexation and Reduction/Oxidation Reactions of Selected Flavonoids with Iron and Iron Complexes: Implications on In-Vitro Antioxidant Activity	**4**
5	**Glycosides and Tannines:** Introduction, Nomenculture, Anthracene glycosides, Anthracene and anthranols, Oxanthrone, Dianthrone, Structure of Saponines, Coumarin glycosides, Flavonide glycosides,	**4**

	Distribuation in nature, Structure of glycosides, Tannines, Pseudotannines, Function of tannins in plants..	
6	**Protein and amino acids :** Classification of Amino Acids, Stereochemistry of Amino Acids, Acid-Base Behavior of Amino Acids, Synthesis of Amino Acids, Reactions of Amino Acids, Some Biochemical Reactions of Amino Acids, Peptides, Introduction to Peptide Structure Determination, Amino Acid Analysis, Peptide Bond Formation. Insulin, Solid-Phase Peptide Synthesis, Enzymes, Co-enzymes.	**4**
7	**Lipids and Fatty acids:** Introduction, Structures,Biological Functions of Lipids, Fatty Acid Naming Systems, Trans Fatty Acids, Wax, Major Types of Lipids, Phosphatidylcholine, Ether Lipids, Sialic Acid, Saponification and Methylation,	**4**
8	**Carbohydrates:** Introduction, Monosaccharides, Structure and Nomenclature of Monosaccharides, Stereochemistry and Configuration of Monosaccharides, Amino sugars, Physical properties of Monosaccharides, Modified Monosaccharides, Ketoses, Glucose, Structure and stereochemistry of glucose, Cyclic structure of monoscaccahrides, Reactions of monosacch-arides, Formation of Osazones, Reaction of Osazones, Disaccharides and Oligosaccharides, Relative Sweetness of Some Carbohydrate and Artificial Sweeteners, Cellulose, Heparin with other examples.	**4**
Total		**30**
Topics to be covered (Laboratories)		
Lab. 1	Testing leaves for Starch	**3**
Lab. 2	Isolation Of Chloroplast	**3**
Lab. 3	Isolation of caffeine from tea leaves	**3**
Lab. 4	Isolation of Nicotine from Tobacco leaves	**3**
Lab. 5	Thin layer Chromatography Characterization of Flavonids	**3**
Lab. 6	Isolation of Lycopene and β-Carotene from Tomato	**3**
Lab. 7	Identification of Plant Pigments by Thin Layer Chromatography	**3**
Lab.	Extraction of Essential Oils from Cinnamon, Clove, and Nigella Sativa by Distillation	**3**
Lab. 9	Estimation of Tannin in Tea	**3**
Lab. 10	Isolation of Piperine	**3**
Total		**30**

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1.0	**Knowledge and Understanding**		
1.1	**To recall functional groups of organic chemistry and their importance in the biosynthesis.**	• Six hours are weekly containing lectures, laboratory activities, and Oral Discussion. • A Private study including home exam.	• Quizzes Assignments • Oral Discussion • Participation.
1.2	**To recognize the structure and molecular classification of a representative number of compounds belonging to the main classes of natural products.**	▪ Six hours are weekly containing lectures, and group discussion ▪ Laboratory activities and discussion.	▪ Quizzes Assignments. • Oral Discussion marks • Laboratory Reports
1.3	**To list relevance of selected natural compounds and some chemical elaboration and outline the structure activity relationship.**	▪ Six hours are weekly for laboratory activities ▪ Think and talk about Natural Products Chemistry	▪ Quizzes ▪ Home exam ▪ Oral Discussions.
2.0	**Skills**		
2.1	**To explain different synthetic strategies pathways in natural products biosynthesis**	• Lectures activity , laboratory activity • Think and talk about Biosynthesis of natural products	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Participation ▪ Oral Discussion, ▪ Laboratory Reports ▪ Home Exam.
2.2	**To predict the bioactivity, properties and chemical structure of some natural products.**	▪ Introduce some examples on the bioactivity properties of some natural products	• Questions in Lectures. • Laboratory Reports • Short Quizzes and Exams.
2.3	**To summarize different situations and problems in isolation of specific natural products group**	• Lectures, laboratory experiments and Group discussion ▪ Brain storming Exercises	▪ Questions in Lectures. ▪ Short Quizzes and Exams.
2.4	**Operate Laboratory Instruments and Perform chemical experiments during Laboratory Classes.**	▪ Encourage the students to use the Chemicals Glass wares and Instruments with caring and safety	▪ Assignments and Laboratory Report.
3.0	**Values**		

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
3.1	**Maintain intellectual and scientific integrity during assignments, projects, and reports**	▪ Group Discussion and Assignments.	▪ Oral Tests and Assignments Marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes, Attendance, Participation, Home Exams**	**All the semester**	**10 %**
2	**Laboratory**	**All the semester**	**30 %**
3	**Midterm Exam 1**	**Around 5th week**	**10 %**
4	**Midterm Exam 2**	**Around 8th week**	**10 %**
5	**Final Exam**	**Around 11th– 12th week**	**40 %**
6	**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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	▪ ***Chemistry of Natural Products***, Bhat, Sujata V., Nagasampagi, Bhimsen A., Sivakumar, Meenakshi Jointly published with Narosa Publishing House 2005, XXX., ISBN: 978-3-540-40669-3 • ***The Chemistry of Natural Products***, Thomson, R.H. Springer, 2nd ed. 1993, **ISBN-10:** 9401049505
Essential References Materials	• ***Medicinal Natural Products: A Biosynthetic Approach***, Dewick, Paul M., Wiley India Pvt Ltd; Third edition, 2011. **ISBN-10:** 8126532963.
Electronic Materials	• **Blackboard**

Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.** • **Each Laboratory should be equipped with maximum 25 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms and laboratories are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey-Observations- Syllabus review-Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Environmental Chemistry**
Course Code:	**CHM 434**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**4(3 Lectures, 2 Lab, 0 Tutorial)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 7 / Year 3**
4. Pre-requisites for this course (if any)**:**	**Instrumental analysis - CHM 332**
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	50	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	30
2	Laboratory/Studio	20
3	Tutorial	0
4	Others (specify)	0
	Total	50

B. Course Objectives and Learning Outcomes

1. Course Description

The objective of this course is to provide student with an understanding of the fundamental chemical processes that are central to important environmental problems. On the other hand students are encouraged to utilize this knowledge in making critical evaluations of these problems.

2. Course Main Objective

At the end of the course, Students should be able to:

- **Understand the fundamental concepts of environmental chemistry.**
- **Develop awareness of the impact of environmental problems and ways to reduce them.**

3. Course Learning Outcomes

	CLOs	AlignedPLOs
1	**Knowledge and Understanding**	
1.1	**To list the components of the environment and recognize the**	**K1, K3**

CLOs		AlignedPLOs
	chemistry of soil, air, and water and to outline the mechanisms by which pollutants can affect their qualities..	
1.2	**To name the important tropospheric processes, photochemical smog and acid precipitation**	**K1, K2**
1.3	**To reproduce some scientific methods employed in environmental chemistry.**	**K2, K3**
2	**Skills:**	
2.1	**To explain methods to determine the extent of environmental pollution and to summarize method of environment monitoring.**	**S1, S2, S3**
2.2	**To analyze the factors affecting the impact of industry and waste disposal upon the environment.**	**S2, S3**
2.3	**To experimentally measure pollution products and to interpret reactivity, and environmental fates of organic and inorganic toxins.**	**S2, S4**
2.4	**To demonstrate oral communication skills by presenting seminars before his class mates and teaching staff, to write reports about real pollution cases in his community and operate electronic mail and Network skills in communicating with others.**	**S2, S3**
3	**Values:**	
3.1	**To appraise coordination in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.**	**V1;V2**

C. Course Content

No	List of Topics	Contact Hours
1	**Environmental Chemistry of water:** Definition of the environment and its components - general introduction to environmental chemistry - properties and sources of water - aquatic chemistry - nitrogen oxides in atmosphere - metal ions and calcium-oxidation reduction - complexation and chelation.	**3**
2	**Water pollution:** Nature and types of water pollutants - elemental pollutants - heavy metals - metalloids - organic and inorganic species - acidity, alkalinity and salinity - oxygen, oxidants and reductants - pesticides, polychlorinated biphenyls and radionuclides in aquatic environment.	**3**
3	**Water treatment:** Water treatment and water use - municipal water treatment - treatment of water for industrial use - sewage water - industrial water treatment - removal of solids - removal of calcium and other metals - removal of dissolved organics and inorganics - sludge - water disinfection - water reuse and recycling.	**3**
4	**The atmosphere and atmospheric chemistry:** Atmosphere - chemistry of atmosphere - importance of atmosphere - physical characteristics of atmosphere - inversions and air pollution - chemical and photochemical reactions in the atmosphere - acid base reaction in the atmosphere - reactions of atmospheric oxygen - reactions of atmospheric nitrogen.	**3**
5	**Inorganic air pollutants**	**3**

	Carbon dioxide - sulfur dioxide sources and sulfur cycle - nitrogen oxides in atmosphere - acid rain - fluorine chlorine and their gaseous compounds.	
6	**Organic air pollutants and photochemical smog:** Pollutant hydrocarbons - photochemical smog - smog-forming automotive emission - smog-forming reactions of organic compounds in the atmosphere - mechanism of smog formation	**3**
7	**Soil environmental chemistry:** Nature and composition of soil - acid-base and ion exchange reactions in soils - nitrogen, phosphorus and potassium in soils - fertilizers - waste and pollutants in soil - preparation of waste for disposal.	**3**
8	**Toxicological chemistry:** Introduction to toxicology and toxicological chemistry - dose-response relationship - toxic elements and elemental forms - toxic inorganic compounds - toxicological chemistry of organic compounds - application of nanomaterials for toxins removal from water - The impact of environmental pollution on human health.	**3**
9	**Industrial Ecology, Resource and Energy:** Metal resource and ecology - world energy resource - energy conservation - petroleum, coal and natural gas - nuclear fission and fusion - the sun energy and energy from biomass	**3**
10	**Environmental analysis:** Introduction of environmental chemical analysis - analysis of water samples - classical methods of water analysis - instrumental methods of water analysis - analysis of waste and solids - atmospheric monitoring - environmental hazards assessment.	**3**
Total		**30**
Topics to be covered (Laboratories)		
Lab 01	**The pH, buffer capacity of environmental water. Alkalinity of streams and lakes & Determination of the Hardness of Natural Waters: A: Conventional EDTA Complexometric Titration. B: Commercial Test Kit Determination**	**2**
Lab 02	**Use of Ion-Selective Electrodes to Determine Trace Levels of Ions in Natural Waters.**	**2**
Lab 03	**Conductivity of Various Waters. & Determination of Chloride Ion in Natural Waters: A Comparison of Methods**	**2**
Lab 04	**Spectrophotometry, Colorimetry and Absorption Spectra: Determining Iron and Manganese in Natural Waters and Sediments**	**2**
Lab 05	**Removal of Chromium (VI) from Wastewater at the Part-Per-Million Level.**	**2**
Lab 06	**Chemical and biochemical oxygen demand**	**2**
Lab 07	**Determination of Oils and Greases by Soxhlet Extraction.**	**2**
Lab 08	**Fluorimetric Determination of Polycyclic Aromatic Hydrocarbons & Analysis of Environmental Hydrocarbons Using Simple Extraction and Analysis by Flame Ionization Detection Gas Chromatography**	**2**
Lab 09	**Kinetics of the Decomposition of Pollutants in the Environment with an Application to nanomaterials**	**2**

Lab 10	Collection and Chemistry of Acid Rain & Determination of the Concentration of Carbon Dioxide in the atmosphere	2
Total		20

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1.0	**Knowledge and Understanding**		
1.1	To list the components of the environment and recognize the chemistry of soil, air, and water and to outline the mechanisms by which pollutants can affect their qualities..	Lecture	Oral tests and MCQs Assays markets Quizzes and homework
1.2	To name the important tropospheric processes, photochemical smog and acid precipitation	Lecture and group discussions	Exams and lab reports
1.3	To reproduce some scientific methods imployed in environmental chemistry.	Lecture and group discussions	In class questions
2.0	**Skills:**		
2.1	To explain methods to determine the extent of environmental pollution and to summarize method of environment monitoring.	• Lectures and group discussion • Brain storming and group discussion	Oral tests Assays and oral questions
2.2	To analyze the factors affecting the impact of industry and waste disposal upon the environment.	• Brain storming	Quizzes
2.3	To experimentally measure pollution products and to interpret reactivity, and environmental fates of organic and inorganic toxins.	• Group discussion and laboratory sessions	Lab reports
2.4	To demonstrate oral communication skills by presenting seminars before his class mates and teaching staff, to write reports about real pollution cases in his community and operate electronic mail and Network skills in communicating	• Group discussion and laboratory sessionsLaboratory experiments	• Lab reports

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
	with others.		
3.0	Values:		
3.1	To appraise coordination in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.	▪ Group Discussion and Assignments.	▪ Oral Tests and Assignments Marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Quizzes, Attendance, Participation and Home works	All the semester	10 %
2	Midterm1	5th -6th week	10 %
3	Midterm 2	8th -9th week	10 %
4	Laboratory	All the semester	30 %
5	Final Exam	11th -12th week	40 %
6	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 :

- **There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.**
- **Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Environmental Chemistry***, Stanley A. Manahan, 7th ed., 2000, Boca Raton: CRC Press LLC: ISBN: 978-1-4398-3276-9.
Essential References Materials	• ***Elements of environmental chemistry, Donald and Hites, John Wiley & sons, Inc. New York, ISBN 978-0-471-99815-0 ISBN 978-0-471-99815-0*** • ***Environmental soil and water chemistry, principles and applications V. P. Evangelou, John Wiley & Sons, Inc. New York. ISBN: 978-0-471-16515-6***
Electronic Materials	▪ **Blackboard** ▪ **http://www.chemistry.college.hmco.com**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.** **Each Laboratory should be equipped with maximum 25 seats and suitable instruments.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**

Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Homogeneous and Heterogeneous Catalysis**
Course Code:	**CHM 447**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 3 (3 Lectures, 0 Lab, 0Tutorials)
2. Course type **a.** University ☐ College ☐ Department ✓ Others ☐ **b.** Required ✓ Elective ☐
3. Level/year at which this course is offered: Level 8 / Year 3
4. Pre-requisites for this course: Colloids and Surface Chemistry - CHM 345
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	30	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	30
2	Laboratory/Studio	0
3	Tutorial	0
4	Others (Mini-reports, Midterm, Final Exam)	0
	Total	30

B. Course Objectives and Learning Outcomes

1. Course Description

This course describes the definitions and types of homogeneous and heterogeneous catalysts, extending to the preparation methods and characterization. This course designed to provide with the concepts of heterogeneous catalysis, theoretical, methodological and technical knowledge of the catalysts and catalytic cycle. The course will cover solution chemistry, organometallic chemistry and physical chemistry in the point of catalysis view.

2. Course Main Objective

At the end of the course, Students should be able:

- ***list the main concepts and applications of homogeneous and heterogeneous catalysis.***
- ***outline the concept of acid-base catalysis and proton transfer.***
- ***describe the acid-base cycle and its industrial application.***
- ***recall the role of organometallics and metallic complexes in catalysis.***
- ***estimate the kinetics and thermodynamic parameters of catalytic reactions.***
- ***evaluate the rate constant of a chemical reaction.***

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To list the main concepts and applications of homogeneous and heterogeneous catalysis.**	**K1; K2; K3**
1.2	**To outline the concept of acid-base catalysis and proton transfer and describe the acid-base cycle and its industrial application.**	**K1; K2; K3**
1.3	**To recall the role of organometallics and metallic complexes in catalysis.**	**K1; K3**
2	**Skills :**	
2.1	**To differentiate homogenous and heterogeneous catalysis mechanisms, and estimate the kinetics and thermodynamic parameters of catalytic reactions.**	**S1; S2; S3**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S2; S3**
2.3	**To demonstrate ability to participate in class by asking questions and giving answers.**	**S3**
2.4	**To demonstrate technical writing and oral communication skills through writing and oral presentation of mini-reports and operate electronic mail and Network in communicating with others.**	**S2;S3**
3	**Values:**	
3.1	**To appraise teamwork and create awareness to maintain scientific integrity during different assessments, projects, and mini-reports.**	**V1, V2**

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction to catalysis**: Fundamental Concepts of Homogeneous catalysis, Fundamental Concepts of Heterogeneous catalysis, advantages and disadvantages, Theoretical bases : Theories of acid-base, Acid-base equilibrium and acidity function	**4**
2	• **Kinetics of proton transfer reactions**: Theory quantum chemistry proton transfer, Theory of the acid-base catalysis the reaction intermediates, Reactions catalyzed by acids and bases, Esterification and hydrolysis of esters, Hydrolysis of amides and acids, Acid catalysis and its industrial applications, Main industrial catalysts, Catalytic cracking, Isomerization of light alkanes	**8**
3	**Transition elements**: Introduction, Definitions, Coordination complexes, Stereochemistry of the transition metal complex, Reactions of transition metal complexes, Notion of catalytic cycle and different types of initiation complex, Tolman rule (16-18 electrons), fundamental reactions of complex, Industrial examples Hydrogenation, asymmetric catalysis, hydrocyanation, Hydroformylation, carbonylation, relationship, Oligomerization and polymerization of olefins, Oxidation reactions. • **Concepts of heterogeneous catalysis**: Introduction and Definition History , catalysts and catalytic properties, general mechanism of action catalyst, Heterogeneous catalysis Area of application: reactions and catalytic processes , catalytic converter, general mechanisms: diffusion,	**10**

	adsorption - desorption kinetics	
4	• **Catalysts:** Classification, synthesis, physicochemical characterization, activation, Notions of adsorption-desorption, Chemisorption and physisorption: Langmuir adsorption isotherm, Langmuir assumptions, Molecular adsorption of a compound, Dissociative adsorption of a compound. Adsorption of several compounds. Other chemisorption isotherm, Physical adsorption isotherm. Different type of isotherm. BET adsorption isotherm	**4**
5	• **Catalytic Cycle**: Irreversible unimolecular reaction. Irreversible bimolecular reaction, Mechanism of Langmuir- Hinshelwood: competitive adsorption and non-competitive. Adsorption mechanism Eley-Rideal	**4**
Total		**30**
Topics to be covered (Laboratories)		
None		

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**		
1.1	**To list the main concepts and applications of homogeneous and heterogeneous catalysis.**	**Lecture**	**Short quizzes**
1.2	**To outline the concept of acid-base catalysis and proton transfer and describe the acid-base cycle and its industrial application.**	**Lecture and group discussions**	**Oral tests and MCQs, Homework**
1.3	**To recall the role of organometallics and metallic complexes in catalysis.**	**Lecture and group discussions**	**Short quizzes oral tests, Homework**
2.0	**Skills**		
2.1	**To differentiate homogenous and heterogeneous catalysis mechanisms, and estimate the kinetics and thermodynamic parameters of catalytic reactions.**	**Lecture and oral discussions**	**Solved problem marks** **Short quizzes and homework assignment**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**Tutorial, Brain storming and self-study**	**Work portfolio and homework**
2.3	**To demonstrate skills to participate in class by asking questions and giving answers.**	**Motivate students to ask questions and to give response.**	**Participation marks**
2.4	**Demonstrate technical writing and oral communication skills through writing and oral presentation of mini-reports and operate electronic mail and Network in**	• **Seminars** • **Group discussion and assignments** **Encourage students to use electronic**	• **Oral tests and presentation marks** • **Assignments and homework**

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	communicating with others.	mail to submit homework and assignments.	marks Group competitions
3.0	**Values**		
3.1	To appraise teamwork and create awareness to maintain scientific integrity during different assessments, projects, and mini-reports.	• Group discussions and assignment. • Homework • Mini-reports	• Oral presentation marks. • Assessments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	20 %
2	Midterm 2	8th/9th weak	20%
3	Quizzes, Home Works, class participation, and mini projects	During the semester	20 %
4	Final Exam	10-11thweek	40 %
5	Total	All weeks	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 :

- There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.
- Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Catalysis: Principles and Applications***, B. Viswanathan, 1st edition, 2002, Narosa, ISBN-10: 0849324246.
Essential References Materials	• ***Catalytic Kinetics***, Dmitry Yu Murzin, Tapio Salmi, 2005, Elsevier, ISBN: 0080455468, 9780080455464. • ***Homogeneous Catalysts: Activity - Stability - Deactivation***, *John C. Chadwick, Rob Duchateau, Zoraida Freixa, Piet W. N. M. van Leeuwen*, 2011, Wiley, ISBN: 978-3-527-32329-6 • ***Heterogeneous Catalysis: Fundamentals and Applications***, J. R. H. Ross Elsevier, 2012, ISBN: 978-0-444-53363-0.

Electronic Materials	• **Blackboard** • **Elsevier**
Other Learning Materials	• **None**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each classroom is equipped with PC and retro projector with a maximum of 25 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.

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	**Council of Chemistry Department**
Reference No.	**21**

Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Solid State & Material Science**
Course Code:	**CHM 448**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**4 (4 Lectures, 0 Lab, 0 Tutorials)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☐ Elective ☑
3. Level/year at which this course is offered:	**Level 8 / Year 3**
4. Pre-requisites for this course:	**Electrochemistry and Corrosion – CHM 343**
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	40	100 %
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	40
2	Laboratory/Studio	0
3	Tutorial	0
4	Others (Mini-reports, Midterm, Final Exam)	0
	Total	40

B. Course Objectives and Learning Outcomes

1. Course Description

The topics covered in this course include: Introduction to solid-state chemistry, periodicity of the elements, atomic structure, bonding, reactions kinetics and mechanisms, semiconductors, band gap, crystal structures, diffraction, amorphous solids, Chemical equilibrium, chemistry of carbon, polymers.

2. Course Main Objective

At the end of the course, Students should be able:

- ***Recognize the basic physical properties of materials based on knowledge of their atomic composition and chemical bonding.***
- ***Describe the structure of crystalline materials using the nomenclature of Bravais lattices and Miller Indices.***
- ***Reproduce the binary phase diagram to quantitatively describe the compositions, phases and microstructures developed during heat treatments of binary solid systems.***
- ***Recall the principles of nucleation theory and solid state diffusion to solve problems involving kinetics of phase transformations in metal alloy systems***
- ***Predict the crystalline structures from Bravais lattices and Miller Indices data.***

Evaluate the optical and thermal properties of materials.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	To recognize the basic physical properties of materials based on knowledge of their atomic composition and chemical bonding.	K1, K2, K3
1.2	To describe the structure of crystalline materials using the nomenclature of Bravais lattices and Miller Indices.	K1, K2, K3
1.3	To recall the principles of nucleation theory and solid state diffusion and describe the compositions, phases and microstructures of solids.	K1, K3
2	**Skills**	
2.1	To construct cubic crystal systems and determines the planes and Miller indices, evaluate the optical and thermal properties of materials.	S1, S2, S3
2.2	To analyze data and results through analytical thinking, with evaluation of the gained information.	S1, S2, S3
2.3	To demonstrate skills to participate in class by asking questions and giving answers.	S3
2.4	To demonstrate oral and network communication and technical writing skills through writing and oral presentation of mini reports, and to operate electronic mail and Network in communicating with others.	S1; S3
3	**Values**	
3.1	To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.	V1, V2

C. Course Content

No	List of Topics	Contact Hours
1	Introduction to solid-state and materials science • (Classifications of Materials and types of Solids).	5
2	• The atomic structure and the electron configurations and the wave- particle Duality	5
3	• Crystal Structures, the 14 Baravis Lattice, the closed packing systems, the crowding and coordination numbers of solid crystals, the crystal axes, planes and Miller indexes	11
4	• X- ray Diffraction and Braggs' equation.	8
5	• Band theory of solids, band gaps and the electrical and thermal conductivity of metals, semiconductors and insulators, magnetic and optical properties of solids, crystal Imperfections, types of crystal defects.	11
	Total	40
Topics to be covered (Laboratories)		

None

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**		
1.1	**To recognize the basic physical properties of materials based on knowledge of their atomic composition and chemical bonding.**	**Lecture**	**Short quizzes**
1.2	**To describe the structure of crystalline materials using the nomenclature of Bravais lattices and Miller Indices.**	**Lecture and group discussions**	**Oral tests and MCQs, Homework**
1.3	**To recall the principles of nucleation theory and solid state diffusion and describe the compositions, phases and microstructures of solids.**	**Lecture and group discussions**	**Homework assignment marks, Oral test and Short quizzes.**
2.0	**Skills**		
2.1	**To construct cubic crystal systems and determines the planes and Miller indices, evaluate the optical and thermal properties of materials.**	**Lectures and laboratory experiments**	**Solved problem marks** **Short quizzes and Laboratory reports** **Numerical problem**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**Brain storming and self-study**	**Work portfolio and homework**
2.3	**To demonstrate skills to participate in class by asking questions and giving answers.**	**Motivate students to ask questions and to give response.**	**Participation marks**
2.4	**To demonstrate oral and network communication and technical writing skills through writing and oral presentation of mini reports, and to operate electronic mail and Network in communicating with others.**	• **Oral participation** • **Group discussions and lab experiment and reports** **Encourage students to use electronic mail to submit homework and assignments.**	• **Oral tests and lab performance, reports and sheets Marks** **Assignments and homework marks**
3.0	**Values**		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
3.1	To appraise coordination in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.	• Group discussion and assignments • homework • Lab-reports • Virtual labs and demonstrations	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	20 %
2	Midterm 2	8th/9th weak	20%
3	Quizzes, Home Works, class participation, and mini projects	During the semester	20 %
5	Final Exam	10-11thweek	40 %
6	Total	All weeks	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 :

- There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.
- Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	***Introduction to Solid-State Chemistry*** 2009, Pearson Custom Publishing (ISBN 10: 0-558-36407-1).
Essential References Materials	***Solid State Chemistry: An Introduction***, Lesley E. Smart, Elaine A. Moore, 4th Edition, 2012 by CRC Press, ISBN 9781439847909.
Electronic Materials	• Blackboard • http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true • http://www.chem1.com/acad/webtext/virtualtextbook.html • http://www.shodor.org/UNChem/index.html

Other Learning Materials	**None**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Each classroom is equipped with PC and retro projector with a maximum of 25 students.** • **Each Laboratory should be equipped with maximum 25 seats**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
	Course Responsible	
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.

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	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Nanochemistry**
Course Code:	**CHM 449**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours: 2 (2 Lectures, 0 Lab, 0Tutorials)
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☐ Elective ☑
3. Level/year at which this course is offered: Level 9 / Year 3
4. Pre-requisites for this course: Colloids and Surface Chemistry - CHM 345
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**	**20**	**100 %**
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**20**
2	**Laboratory/Studio**	**0**
3	**Tutorial**	**0**
4	**Others** (Mini-reports, Midterm, Final Exam)	**0**
	Total	**20**

B. Course Objectives and Learning Outcomes

1. Course Description

The course covers the following topics: Inorganic Materials Chemistry and Nanochemistry; Basics Nanomaterials, Nanoparticles: Types, compositions, and structures. The course will extend to Metal and semiconductor nanocrystals, Porous inorganic nanoparticles, Organic nanoparticles. It also designed to cover Optical characterization and structural characterization.

2. Course Main Objective

At the end of the course, Students should be able:

- ***To recognize the basic information of nanochemistry and nanomaterials concepts and their applications.***
- ***To describe the concept of nanomaterials preparation***
- ***To state the application of nanochemistry and nanotechnology in the industrial field.***
- ***To outline the physical and chemical characterization of nanomaterials.***
- ***To differentiate between the different types of nanomaterials.***

- *To predict the physical properties of nanomaterials.*

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**To recognize the basic information of nanochemistry and nanomaterials concepts and their applications.**	**K1; K2; K3**
1.2	**To describe the concept of nanomaterials preparation**	**K1; K2; K3**
1.3	**To state the application of nanochemistry and nanotechnology in the industrial field.**	**K1**
1.4	**To outline the physical and chemical characterization of nanomaterials.**	**K1; K3**
2	**Skills :**	
2.1	**To differentiate between the different types of nanomaterials, and summarize the nanomaterials synthesis.**	**S1, S2, S3,**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1, S2, S3**
2.3	**To demonstrate skills to participate in class by asking questions and giving answers. To demonstrate oral and network communication, technical writing skills through writing, oral presentation of mini reports**	**S3**
3	**Values:**	
3.1	**To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.**	**V1, V2**

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction to nanochemistry**: Inorganic Materials Chemistry and Nanochemistry; Basics Nanomaterials, Nanoparticles: Types, compositions, and structures.	**3**
2	**Metal and semiconductor nanocrystals**: Porous inorganic nanoparticles, Organic (latexes), Carbon-based nanoparticles (carbon nanotubes, grapheme), Porous inorganic nanoparticles, Organic (latexes) and carbon-based nanoparticles (carbon nanotubes, graphene), Nanoparticle synthesis: Basic synthesis and fabrication methods for nanomaterials (CVD, sol-gel, microemulsion, template, hydrothermal) , Classical Colloid Theory: Nucleation and growth, Ostwald ripening, Homogeneous vs. heterogeneous nucleation, Applications of nanomaterials, Anisotropic growth and shape control, Catalyzed (seeded) growth, Nanocrystal doping, solid solutions and Vegard's rule	**9**
3	**Optical characterization**: Absorption and photoluminescence (PL & PLE) spectroscopies, steady-state vs. fast spectroscopy, dynamic light scattering **Structural characterization**: XRD, TEM, AFM, Deviations between bulk and near-surface crystal structures **Chemistry of small surfaces**: Curvature and neighboring-charge effects on chemical reactivity and equilibria (pKa's, redox potentials) **Applications in structural materials**, imaging, lighting, energy conversion (Solar Cells), catalysis and Photocatalysis (Environmental remediation) and Nano-electronics/Nano-photonics Applications	**8**

	Environmental, safety, and ethical aspects of nanotechnology	
Total		**20**
Topics to be covered (Laboratories)		
None		

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**		
1.1	**To recognize the basic information of nanochemistry and nanomaterials concepts and their applications.**	**Lecture**	**Short quizzes**
1.2	**To describe the concept of nanomaterials preparation**	**Lecture and group discussions**	**Oral tests and MCQs, Homework**
1.3	**To state the application of nanochemistry and nanotechnology in the industrial field.**	**Lecture and group discussions**	**Short quizzes oral tests, Homework**
1.4	**To outline the physical and chemical characterization of nanomaterials.**	**Lecture and group discussions**	**Oral tests and MCQs**
2.0	**Skills**		
2.1	**To differentiate between the different types of nanomaterials, and summarize the nanomaterials synthesis.**	**Lecture and oral discussions**	**Solved problem marks** **Short quizzes and homework assignment**
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**Tutorial, Brain storming and self-study**	**Work portfolio and homework**
2.3	**To demonstrate skills to participate in class by asking questions and giving answers. To demonstrate oral and network communication, technical writing skills through writing, oral presentation of mini reports**	**Motivate students to ask questions and to give response.** **Encourage students to use electronic mail and blackboard to submit works and assignments.**	**Participation marks**
3.0	**Values**		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
3.1	To appraise teamwork, and create awareness to maintain scientific integrity during different assessments, projects, and mini reports.	• Seminars • Group discussion and assignments • Homeworks • Mini reports	• Presentation marks • Oral tests • Assignments and homeworks • Mini reports assignment

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm 1	5th/ 6th week	20 %
2	Midterm 2	8th/9th weak	20%
3	Quizzes, Homeworks, class participation, and mini projects	During the semester	20 %
4	Final Exam	10-11thweek	40 %
5	Total	All weeks	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 :

- There are 2 office hours per week reserved by each staff member, planed on his timetable, to help the students to solve their problems.
- Each department has an academic advisor who will act as a mentor, providing academic and career advice and general counseling.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• ***Nanochemistry,*** G.B. Sergeev, K.J. Klabunde, Elsevier, 2013, ISBN: 978-0-444-59397-9
Essential References Materials	• ***Nanoscale Science and Technology,*** Robert Kelsall, Ian W. Hamley , Mark Geoghegan, Wiley | 2005-04-29 | ISBN: 0470850868 • **Nanomaterials and Nanochemistry,** C Brechignac, P Houdy, M Lahmani2011, Wiley, ISBN: 0444593977
Electronic Materials	• Blackboard • http://highered.mcgrawhill.com/classware/ala.do?isbn=0073048518&alaid=ala_1136810&protected=true&showSelfStudyTree=true • http://www.chem1.com/acad/webtext/virtualtextbook.html • http://www.shodor.org/UNChem/index.html
Other Learning Materials	• None

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Each classroom is equipped with PC and retro projector with a maximum of 25 students.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.

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	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Research Project**
Course Code:	**CHM 461**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**

Table of Contents

A. Course Identification

1. Credit hours:	**4 (6 Lectures, Lab, and Tutorial)**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	**Level 9 / Year 3**
4. Pre-requisites for this course (if any)**:**	**Research project course starts in the last semester of the program study (3th year – 9thsemester).**
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	60	100%
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	10
2	Laboratory/Studio	40
3	Library	10
4	Others (Mini-reports, Midterm, Final Exam)	0
	Total	60

B. Course Objectives and Learning Outcomes

1. Course Description

Graduation Project is an independent task to be carried out by each student individually and accomplished according to a specific timetable duration. Students should achieve the project within one semester. Graduation project is a solo act based on one major department topics and is supervised by one of the staff members. The department assigns a scientific committee with the project supervisor to evaluate and discuss the project in a pre-stated date before the final exam. The student is given freedom to a great extent in choosing the graduation

project title; the selected topic will focus on, and follow with the aid of the supervising professor

2. Course Main Objective

After completing the project, the student is supposed to acquire the necessary skills in the following:

- Be able to carry out a guided graduation project independently.
- Be able to attend and practice his obtained knowledge and information during his chemistry program appropriately.
- Be able to search and communicate with the faculty member scientifically.
- Be able to develop his intellectual abilities in scientific research.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge:**	
1.1	To recall basic concepts and knowledge to initiate the graduation project	K1, K2, K3
1.2	To list the scientific approach for interpreting the obtained data, to describe the obtained results in appropriate form, to outline in-depth knowledge of currently active research areas in Chemistry	K1, K3
1.3	To write the scientific report supported with obtained results and conclusion	S2, K3
2	**Skills:**	
2.1	To develop experience in searching and assessing current literature.	S1, S3
2.2	To analyze obtained data independently with supervisor guidance and to explain obtained results through scientifically logic thinking, with evaluation of the gained information.	S1, S3, S4
2.3	To interpret the different results taken from various techniques used.	S1, S3, S4
3	**Values**	
3.1	To illustrate the active participation by oral discussion, to demonstrate creative and innovative approaches to his (her) research project subject.	S1, V1, V2
3.2	To show ability to communicate effectively with the supervisor, to revise and improve written and visual content and use appropriate technology to achieve desired outcomes, to comprehend information accessed through reading and discussion.	V1, V2

C. Course Content

No	List of Topics	Contact Hours
1	Collection a background and literature review on the suggested work.	10

2	**The student carries out a guided independent study with review of research background and literatures in selected topic in chemistry. The project can be done with laboratory work.**	**46**
3	**Discussion by oral presentation**	**4**
Total		**60**

D. Teaching and Assessment

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

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
1.0	**Knowledge and Understanding**		
1.1	**To recall basic concepts and knowledge to initiate the graduation project**	• Three hours are weekly containing literature survey with supervisor guidance. • Students are encouraged to make regular visits during office hours where they can ask any question about the course.	• Continuous evaluation of the research supervisor • Written the collected the literature survey • Oral Discussion
1.2	**To list the scientific approach for interpreting the obtained data, to describe the obtained results in appropriate form, to outline in-depth knowledge of currently active research areas in Chemistry**	• Three hours are weekly containing laboratory activities under supervisor guidance. • Think and talk to interpret the obtained results.	• Continuous evaluation of the research supervisor • Self-interpreting check with the supervisor • Oral Discussion
1.3	**To write the scientific report supported with obtained results and conclusion**	Practice the scientific writing of the project with aid of the supervisor.	• Self- Written report • Oral Discussion
2.0	**Skills:**		
2.1	**To develop experience in searching and assessing current literature.**	Independent developing under the guidance of the research supervisor through under discussion weekly.	• Continuous evaluation of the research supervisor • Written report • Oral discussion
2.2	**To analyze obtained data independently with supervisor guidance and to explain obtained results through scientifically logic thinking, with evaluation of the gained information.**	Independent data analysis under the guidance of the research supervisor including further discussion.	• Continuous evaluation of the research supervisor • Written report • Oral discussion

Code	Course Learning Outcomes	TeachingStrategies	AssessmentMethods
2.3	**To interpret the different results taken from various techniques used.**	Laboratory experiments and self-study	• Laboratory reports • Oral discussion
3.0	**Values**		
3.1	**To illustrate the active participation by oral discussion, to demonstrate creative and innovative approaches to his (her) research project subject.**	• Motivate students to discuss the graduation project topic. • Oral discussions	**Oral Discussion.** **Continuous evaluation of the research supervisor** **Oral presentation marks**
3.2	**To show ability to communicate effectively with the supervisor, to revise and improve written and visual content and use appropriate technology to achieve desired outcomes, to comprehend information accessed through reading and discussion.**	• Independent study under the guidance of the research supervisor with further discussion with supervisor weekly. • Simulation of presentation monitored by the supervisor.	**Oral Discussion.** **Continuous evaluation of the research supervisor** **Written report.**

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	First continuous evaluation (reported by the supervisor)	4th week	20%
2	Second continuous evaluation (reported by the supervisor)	9th week	30%
3	Written report in English (20-35 pages)	During the semester	50%
4	Short talk in English language (oral presentation 15 minutes)	11th week	
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 :

- **Each student admitted to the bachelor program will be assigned an academic advisor to give him the appropriate academic counselling and support.**
- **The lecturer for each course will allocate 6 office hours per week, these times will be advertised on the office door, and reserved by the instructor as part of his teaching schedule to help the students on any academic problems/difficulties.**
- **The student is able to get individual consultation and academic advice appointment with teaching staff via e-mail or phone calls.**
- **A list of teaching staff members with their room numbers, their phone numbers and their e-mail addresses is given in the BSc. Applied Mathematics Handbook and Department website.**

F. Learning Resources and Facilities

Students will be guided by study notes, books, research articles and original sources (or English translations where necessary), which are provided. The students will need to master the appropriate mathematics and ultimately present his /her work in the form of a final presentation. Other appropriate learning resources are possible related to the nature of the research project.

1.Learning Resources

Required Textbooks	
Essential References Materials	
Electronic Materials	
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• **Lab. containing different apparatus for preparation and characterization.** • **Microsoft Office, internet access to use the electronic resources provided by the University Library.**
Technology Resources (AV, data show, Smart Board, software, etc.)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	**None**

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
		Indirect: Second examiner checklist- Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Extent of achievement of course learning outcomes	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist- Course report.
	Program Leaders	**Indirect:** Exams.
Quality of learning resources	Students	**Indirect:** Second examiner checklist- Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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

H. Specification Approval Data

Council / Committee	**Council of Chemistry Department**
Reference No.	**21**
Date	**29/7/1443**