



## Course Specifications

<b>Course Title:</b>	Solid State Chemistry
<b>Course Code:</b>	4024582-2
<b>Program:</b>	Chemistry
<b>Department:</b>	Department of Chemistry
<b>College:</b>	Faculty of Applied Science
<b>Institution:</b>	Umm Al-Qura University

## Table of Contents

<b>A. Course Identification</b> .....	<b>3</b>
6. Mode of Instruction (mark all that apply) .....	3
<b>B. Course Objectives and Learning Outcomes</b> .....	<b>3</b>
1. Course Description .....	3
2. Course Main Objective.....	3
3. Course Learning Outcomes .....	4
<b>C. Course Content</b> .....	<b>4</b>
<b>D. Teaching and Assessment</b> .....	<b>5</b>
1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods .....	5
2. Assessment Tasks for Students .....	6
<b>E. Student Academic Counseling and Support</b> .....	<b>6</b>
<b>F. Learning Resources and Facilities</b> .....	<b>6</b>
1. Learning Resources .....	7
2. Facilities Required.....	8
<b>G. Course Quality Evaluation</b> .....	<b>8</b>
<b>H. Specification Approval Data</b> .....	<b>8</b>

## A. Course Identification

<b>1. Credit hours:</b> <b>2 theoretical</b>
<b>2. Course type</b> a. University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/> b. Required <input checked="" type="checkbox"/> Elective <input type="checkbox"/>
<b>3. Level/year at which this course is offered:</b> 7 <sup>th</sup> level / 4 <sup>th</sup> year
<b>4. Pre-requisites for this course (if any):</b> Coordination Chemistry
<b>5. Co-requisites for this course (if any):</b> Nothing

### 6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	√	75 %
2	Blended	---	---
3	E-learning	---	25%
4	Distance learning	---	---
5	Other	---	---

### 7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	22
2	Laboratory/Studio	0
3	Tutorial	0
4	Others (E- learning + Exams + office hours)	10
	<b>Total</b>	<b>32</b>

## B. Course Objectives and Learning Outcomes

### 1. Course Description

This course reports the essential concepts of crystal structures properties such as crystal structures properties, symmetry operators, X- ray diffractions, Bragg's law, Miller indices, crystal defects and types of defects in solids.

### 2. Course Main Objective

The main purpose for this course is to study:

- The bases of solid state chemistry.
- Crystallography and their kinds.
- The effect of X-ray on different crystals

The crystallographic shapes and semiconductors.

### 3. Course Learning Outcomes

CLOs		Aligned PLOs
<b>1</b>	<b>Knowledge and Understanding</b>	
1.1	Demonstrate the understanding of the basic principles of solid state chemistry and solid state structures.	<b>K1</b>
1.2	Recall the crystal systems and their properties and how different between polymorphism and isomorphism.	<b>K2</b>
1.3	Define X-ray diffraction in the crystal structure-X-ray absorption- X-Ray spectrum-experimental crystal study (Lewis method-Rotatable crystal-powder diffraction)	<b>K2</b>
<b>1.4</b>	Recognize the application of solid state chemistry and its importance in our life	<b>K3</b>
<b>2</b>	<b>Skills :</b>	
2.1	Calculate the concentrations of the defects according to types of defects.	<b>S2</b>
2.2	Applies the Miller semantics, calculates the size of the unit, determines the power of the grid, and identifies the unit building structure.	<b>S1</b>
2.3	Define the crystal system and their properties such as no of molecules , coordination numbers for the different cubic systems	<b>S2</b>
2.4	Communicate effectively using theoretical basis of solid-state chemistry to a variety of audiences	<b>S4</b>
2.5	use the information technology that will enable them to gather, interpret, and communicate information and ideas	<b>S5</b>
<b>3</b>	<b>Values:</b>	
3.1	Write and present a chemical report related to solid state chemistry.	<b>V2</b>
3.2	work individually and in a team to perform a specific experiment or preparing a report on the solid state chemistry	<b>V3</b>
3.3	Demonstrate commitment to professional and academic values and ethics	<b>V1</b>

### C. Course Content

No	List of Topics	Contact Hours
1	Introduction to solid state chemistry	2
2	Study the crystal structures properties, crystal lattice, type of crystals (covalent -ionic)-cubic centered face-cubic centered body.	2
3	Learn Bravais lattices	2
4	Study the symmetry operators , elements and axis of rotation, symmetry and point group of molecules and point group of unit cells-point groups and space groups	2
5	Calculate the volume of the unit cell , atomic radius , number of molecules , close and square packing and the density.	2
6	Midterm exam	<b>1</b>
7	X- ray diffractions and Bragg's law	2
8	Crystal structure of solids: Solid crystallography-X-Ray crystallography(interference phenomenon and diffraction method)	2

9	X-ray diffraction in the crystal structure-X-ray absorption- X-Ray spectrum-experimental crystal study(Lewis method-Rotatable crystal-powder diffraction)	4
10	How to calculate Miller indices of directions and planes-calculate inter-planar d -spacing (dhkl)	2
11	The crystal binding in solid Material, lattice energy and ionic charge.	2
	How to detect the crystal defects and types of defects.	3E
	Effect of impurities on the properties of semiconductors (n-type and p-type semiconductor).	3E
	Final exam	2
<b>Total</b>		<b>31</b>

## D. Teaching and Assessment

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

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
<b>1.0</b>	<b>Knowledge and Understanding</b>		
1.1	Demonstrate the understanding of the basic principles of solid state chemistry and solid state structures.	- Lectures. - Dialogue and discussion	midterm exam and final exams that consist of the following types of knowledge questions (30% of final assessment): 20 % assessment for Quizzes, open discussion as groups and homework at e-learning 50% the final exam
1.2	Recall the crystal systems and their properties and how different between polymorphism and isomorphism.	- Video shows - Assignment on e-learning cite of the University	
1.3	Define X-ray diffraction in the crystal structure-X-ray absorption- X-Ray spectrum-experimental crystal study (Lewis method-Rotatable crystal-powder diffraction)		
<b>1.4</b>	Recognize the application of solid state chemistry and its importance in our life		
<b>2.0</b>	<b>Skills</b>		
2.1	Calculate the concentrations of the defects according to types of defects.	- lecture using smart classes	-Two midterm and final exams that consist of the following types of cognitive skills questions (30% of mid assessment): - (10 % of final assessment): Homework assignments. - (10 % of final assessment on blackboard) : Quizzes Final exam (50%)
2.2	Applies the Miller semantics, calculates the size of the unit, determines the power of the grid, and identifies the unit building structure.	- Dialogue and discussion. - Posting many examples and questions on the web page as homework.	
2.3	Define the crystal system and their properties such as no of molecules , coordination numbers for the different cubic systems	- Offering the available references in the library and websites specialized in this field for the students. - Demonstrating the different shapes for cubic systems ,	
2.4	Communicate effectively using theoretical basis of solid-state chemistry to a variety of audiences		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
		conduction in metals using videos - Offering the different Models for Bravais lattices and lattice types	
2.5	use the information technology that will enable them to gather, interpret, and communicate information and ideas		
<b>3.0</b>	<b>Values</b>		
3.1	Write and present a chemical report related to solid state chemistry.	-Distribute students to different groups to acquire skills of dealing with everyone. - Discussion in groups - Written reports about one of topic related of the course	-Assessment of assignments includes portion of grade for effectiveness of investigation processes. -Personal performance in classroom.
3.2	work individually and in a team to perform a specific experiment or preparing a report on the solid state chemistry		
3.3	Demonstrate commitment to professional and academic values and ethics		

## 2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Assignments and activities	All weeks	10 %
2	E-learning	All weeks	10 %
3	Mid-term Exam	6	30 %
4	Final Exam (2 hours exam)	12	50 %

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

## E. Student Academic Counseling and Support

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

- Office hours: During the working hours weekly,
- Academic advising for students.

Availability of Staff members to provide counseling and advice.

## F. Learning Resources and Facilities

## 1. Learning Resources

<p><b>Required Textbooks</b></p>	<ul style="list-style-type: none"> <li>• Lesley E. Smart, Elaine A. Moore, Solid State Chemistry: An Introduction, 4<sup>th</sup>, CRC press (Taylor &amp; Frances) 2012</li> <li>Lesley E. Smart, Elaine A. Moore, Solid State Chemistry ; An Introduction, 3<sup>rd</sup>, Taylor &amp; Francis Group, 2005 LLC</li> </ul>
<p><b>Essential References Materials</b></p>	<ul style="list-style-type: none"> <li>• Lesley E. Smart, Elaine A. Moore, Solid State Chemistry: An Introduction, 4<sup>th</sup>, CRC press (Taylor &amp; Frances) 2012</li> <li>Lesley E. Smart, Elaine A. Moore, Solid State Chemistry ; An Introduction, 3<sup>rd</sup>, Taylor &amp; Francis Group, 2005 LLC</li> </ul>
<p><b>Electronic Materials</b></p>	<ul style="list-style-type: none"> <li>• <a href="http://www.mx.iucr.org/iucr-top/comm/cteach/pamphlets/13/node5.html">http://www.mx.iucr.org/iucr-top/comm/cteach/pamphlets/13/node5.html</a></li> <li>• <a href="http://img.chem.ucl.ac.uk/sgp/mainmenu.htm">http://img.chem.ucl.ac.uk/sgp/mainmenu.htm</a></li> <li>• <a href="http://www.shef.ac.uk/.../solid-state-chemistry-applications-msc">www.shef.ac.uk/.../solid-state-chemistry-applications-msc</a></li> <li>• <a href="http://www.simplybooks.in/solid-state-chemistry-its-anthony-r-book..">www.simplybooks.in/solid-state-chemistry-its-anthony-r-book..</a></li> <li>• <a href="http://www.infibeam.com/.../solid-state-chemistry-its-applications/9...">www.infibeam.com/.../solid-state-chemistry-its-applications/9...</a></li> <li>• <a href="http://www.seas.upenn.edu/~chem101/sschem/solidstatechem.html">http://www.seas.upenn.edu/~chem101/sschem/solidstatechem.html</a></li> <li>• <a href="http://www.webqc.org/symmetry.php">http://www.webqc.org/symmetry.php</a></li> <li>• <a href="http://en.wikipedia.org/wiki/Molecular_geometry">http://en.wikipedia.org/wiki/Molecular_geometry</a></li> <li>• <a href="http://en.wikipedia.org/wiki/Molecular_graphics">http://en.wikipedia.org/wiki/Molecular_graphics</a></li> <li>• <a href="http://butane.chem.uiuc.edu/cyerkes/Chem102AEFa07/Lecture_Notes_102/newL102.htm-ecture%2014">http://butane.chem.uiuc.edu/cyerkes/Chem102AEFa07/Lecture_Notes_102/newL102.htm-ecture%2014</a></li> <li>• <a href="http://www.wyzant.com/Help">/Science/Chemistry/Lewis_Structures_VSEPRhttp://www.wyzant.com/Help</a></li> <li>• <a href="http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro3.htm">http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro3.htm</a></li> <li>• <a href="http://www.drills.com/VSEPR.php-.chemistryhttp://www">drills.com/VSEPR.php-.chemistryhttp://www</a></li> <li>• <a href="http://cat.middlebury.edu/~chem/chemistry/class/general/ch103/chapter9/Test.html">http://cat.middlebury.edu/~chem/chemistry/class/general/ch103/chapter9/Test.html</a></li> <li>• <a href="http://kiel.de/herges/modeling/gliederung.html">kiel.de/herges/modeling/gliederung.html</a>-<a href="http://scholle.oc.uni">http://scholle.oc.uni</a></li> <li>• <a href="http://faculty.ucsd.edu/trogler/GroupTheory224/Grouptheory.html">faculty.ucsd.edu/trogler/GroupTheory224/Grouptheory.html</a>-<a href="http://chem">http://chem</a></li> <li>• <a href="http://www.seas.upenn.edu/~chem101/sschem/solidstatechem.html">http://www.seas.upenn.edu/~chem101/sschem/solidstatechem.html</a></li> <li>• <a href="http://phycomp.technion.ac.il/~ira/types.html">http://phycomp.technion.ac.il/~ira/types.html</a></li> <li>• <a href="http://en.wikipedia.org/wiki/Solid-state_chemistry">http://en.wikipedia.org/wiki/Solid-state_chemistry</a></li> <li>• <a href="http://www.shef.ac.uk/.../solid-state-chemistry-applications-msc">www.shef.ac.uk/.../solid-state-chemistry-applications-msc</a></li> <li>• <a href="http://www.simplybooks.in/solid-state-chemistry-its-anthony-r-book..">www.simplybooks.in/solid-state-chemistry-its-anthony-r-book..</a></li> <li>• <a href="http://www.infibeam.com/.../solid-state-chemistry-its-applications/9...">www.infibeam.com/.../solid-state-chemistry-its-applications/9...</a></li> <li>• <a href="http://books.google.com.sa/books?id=-EKcm5UQaqEC&amp;hl=ar&amp;redir_esc=y">http://books.google.com.sa/books?id=-EKcm5UQaqEC&amp;hl=ar&amp;redir_esc=y</a></li> </ul>
<p><b>Other Learning Materials</b></p>	<ul style="list-style-type: none"> <li>• Isisdraw and Chemdraw and Chemoffice</li> <li>• -MS-Office Software</li> <li>• <a href="http://scholle.oc.uni-kiel.de/herges/modeling/gliederung.html">http://scholle.oc.uni-kiel.de/herges/modeling/gliederung.html</a></li> <li>• <a href="http://chem-faculty.ucsd.edu/trogler/GroupTheory224/Grouptheory.html">http://chem-faculty.ucsd.edu/trogler/GroupTheory224/Grouptheory.html</a></li> <li>• <a href="http://phycomp.technion.ac.il/~ira/types.html">http://phycomp.technion.ac.il/~ira/types.html</a></li> </ul>

## 2. Facilities Required

Item	Resources
<b>Accommodation</b> (Classrooms, laboratories, demonstration rooms/labs, etc.)	A classroom containing at least 45 seats and equipped with projector and Internet access (scheduled for 2 hours once a week).
<b>Technology Resources</b> (AV, data show, Smart Board, software, etc.)	- Common computer lab containing at least 25 computer sets. - High speed internet access.
<b>Other Resources</b> (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Isidraw and Chemdraw and Chemoffice

## G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Quality of learning resources	Students	Periodically, completing the questionnaire evaluation of the course.
Effectiveness of teaching and assessment.	Program Leaders	Reviewing of final exams and the student's degrees in different exams.
Extent of achievement of course learning outcomes.	Peer Reviewer	Checking selected exam papers, and student assignments.

**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

<b>Council / Committee</b>	Quality committee and department Council
<b>Reference No.</b>	1 <sup>st</sup> meeting
<b>Date</b>	2021

**Head of Chemistry Department**

  
**Dr Moataz Morad**

