



# Course Specifications

<b>Course Title:</b>	Solid State Chemistry
<b>Course Code:</b>	325CHEM-2
<b>Program:</b>	Bachelor of Science in Chemistry
<b>Department:</b>	Chemistry
<b>College:</b>	Science
<b>Institution:</b>	King Khalid 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.....	4
3. Course Learning Outcomes .....	4
<b>C. Course Content</b> .....	<b>5</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 .....	7
<b>E. Student Academic Counseling and Support</b> .....	<b>7</b>
<b>F. Learning Resources and Facilities</b> .....	<b>7</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: 2</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: Year 3 (Level 6)</b>
<b>4. Pre-requisites for this course (if any): 102 CHEM-2</b>
<b>5. Co-requisites for this course (if any): No co-requisite</b>

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

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	2	100%
2	Blended	0	0%
3	E-learning	0	0%
4	Correspondence	0	0%
5	Other	0	0%

### 7. Actual Learning Hours (based on academic semester)

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

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

## B. Course Objectives and Learning Outcomes

### 1. Course Description

The course deals with the study of the solid-state chemistry of pure crystalline materials. This course aims to introduce the crystal structure, crystalline systems, crystal symmetry and types of crystalline solids. In addition, the use of X-rays to identify the crystal structure as well as to identify crystal defects and semiconductors and their practical applications. This course also give short introduction to the cement industry.

## 2. Course Main Objective

- Understand the concepts of basic principles of solid state.
- Identification of crystal system and their properties, polymorphism and isomorphism
- Learn how to deal with the crystal structures, lattice, cubic unit cells, basis, point groups, space groups, reflection cubic unit cells, Bravais lattices and lattice types.
- Understand the symmetry operators, elements and axis of rotation.
- Learn how to calculate Miller Indices of directions and planes.
- Learn how to calculate the volume of the unit cell, atomic radius, number of molecules, close packing and the density for a face, body centered cubic unit cell.
- Understand the crystal binding in solid Material.
- Study the Bragg' Law Model and learn how to calculate the cubic crystal , order of reflection , x-ray wavelength , spacing between planes and angle between incident x-ray beam and crystal planes (hkl)
- Learn the crystal defects, types of defects (point, line, surface) and how to calculate the concentrations of the defects according to types of defects.
- Learn the band theory and conduction in metallic solids
- Understand the Metallic alloys, solid solutions.
- Study the cement industry ( structure , types , methods of preparations , uses )

## 3. Course Learning Outcomes

CLOs		Aligned PLOs
<b>1</b>	<b>Knowledge:</b>	
1.1	Know the difference between crystalline and non-crystallin solids.	<b>K1, K3</b>
1.2	Define the crystal lattice, crystal structure and unit cell.	<b>K1</b>
1.3	State the seven crystal systems and their Bravais lattices	<b>K1</b>
1.4	Present the symmetry elements and operations in crystals	<b>K1</b>
1.5	Describe the types of crystals based on bonding	<b>K1</b>
1.6	Know the principals of X-ray diffraction (XRD) by crystalline solids	<b>K1, K3</b>
1.7	Memorize different techniques for measuring XRD	<b>K1, K3</b>
1.8	Define crystal defects and types of defects	<b>K1, K3</b>
1.9	Know the importance of alloys and their preparation methods	<b>K1, K3</b>
1.10	Show the band theory and conduction in semiconductors	<b>K1, K3</b>
1.11	Know the compounds, row-materials, types of cements	<b>K1, K3</b>
<b>2</b>	<b>Skills :</b>	
2.1	Distinguish between crystalline and non-crystallin solids using meting curves and XRD	<b>S1, S3</b>
2.2	Use a, b, c, $\alpha$ , $\beta$ and $\gamma$ parameters to explain the unit cell.	<b>S1, S3</b>
2.3	Learn how to calculate the volume of the unit cell, atomic radius, number of molecules, close packing and density for cubic lattices.	<b>S1</b>
2.4	Understand the symmetry operators, elements and axis of rotation.	<b>S1</b>
2.5	Learn how to calculate Miller Indices of directions and planes	<b>S1, S3</b>
2.6	Use the Bragg' Law to calculate the cubic crystal parameters, spacing between planes and angle between incident x-ray beam and crystal planes (hkl)	<b>S1, S3</b>
2.7	Calculate the concentrations of the defects according to types of defects	<b>S1, S3</b>

CLOs		Aligned PLOs
2.8	Understand the effect of temperature and addition of impurities on the conductivity of semiconductors	S1, S3
<b>3</b>	<b>Competence:</b>	
3.1	To present an oral explanation for a subject in the area.	C1, C3
3.2	To interact positively with colleagues in a group work.	C1, C2
3.3	To contribute with colleagues to prepare and deliver a presentation and report of group work	C4, C5
3.4	To summarize the literature and sources for an area in the course.	C2, C3

### C. Course Content

No	List of Topics	Contact Hours
1	Background Review: Understand the concepts of basic principles of solid state, references, textbook, methods of assessment, time sheet of the first, second and final exams.	3
2	Crystalline and non-crystalline solids, crystal structure, lattice, unit cells in solid state, crystal systems and Bravais lattices	4
3	Properties of Cubic lattices: calculate the volume of the unit cell, atomic radius, number of atoms, density and close packing	4
4	Crystal symmetry: Symmetry operators, elements in crystals (Symmetry axis, plane of symmetry and center of symmetry).	3
5	Crystal binding in solid Material: ionic, covalent, metallic and molecular solids.	2
6	Miller Indices of directions and planes and inter-planar spacing ( $d_{hkl}$ )	2
7	X- ray diffraction: X-ray properties, Diffraction, Bragg's law, Techniques for measuring of XRD, interpretation of XRD pattern.	4
8	Crystal defects, types of defects (point, line and surface) and Determination the concentrations of the defects according to types of defects	2
9	Metallic alloys: importance, preparations, types and factors affecting the formation of solid solutions	2
10	Conduction in solid materials: Band theory, Semiconductors, p-n junction	2
11	Chemistry of cement industry (Chemical structure, types, raw materials and methods of preparations)	2
<b>Total</b>		<b>30</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
1.0	<b>Knowledge</b>		
1.1	Know the difference between crystalline and non-crystallin solids.	Lectures, discussion	Assignments, Quizzes and exams (midterm and final)
1.2	Define the crystal lattice, crystal structure and unit cell.	Lectures, Video shows	
1.3	State the seven crystal systems and	Lectures, Video shows,	

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	their Bravais lattices	discussion	Assignments, Quizzes and exams (midterm and final)
1.4	Present the symmetry elements and operations in crystals	Lectures, Video shows, discussion	
1.5	Describe the types of crystals based on bonding	Lectures, discussion	
1.6	Know the principals of X-ray diffraction (XRD) by crystalline solids	Lectures, Video shows, problem solving	
1.7	Memorize different techniques for measuring XRD	Lectures, Video shows, discussion	
1.8	Define crystal defects and types of defects	Lectures, Video shows	
1.9	Know the importance of alloys and their preparation methods	Lectures, discussion	
1.10	Show the band theory and conduction in semiconductors	Lectures, discussion	
1.11	Know the compounds, row-materials, types of cements	Lectures, Video shows, discussion	
<b>2.0</b>	<b>Skills</b>		
2.1	Distinguish between crystalline and non-crystallin solids using meting curves and XRD	Lectures, Tutorials, discussion	Assignments, Quizzes and exams (midterm and final)
2.2	Use a, b, c, $\alpha$ , $\beta$ and $\gamma$ parameters to explain the unit cell.	Lectures, Video shows, problem solving, Tutorials, discussion	
2.3	Learn how to calculate the volume of the unit cell, atomic radius, number of molecules, close packing and density for cubic lattices.	Lectures, Video shows, problem solving, Tutorials, discussion	
2.4	Understand the symmetry operators, elements and axis of rotation.	Lectures, Video shows, problem solving, Tutorials	
2.5	Learn how to calculate Miller Indices of directions and planes	Lectures, problem solving, Tutorials, discussion	
2.6	Use the Bragg' Law to calculate the cubic crystal parameters, spacing between planes and angle between incident x-ray beam and crystal planes (hkl)	Lectures, problem solving, Tutorials,	
2.7	Calculate the concentrations of the defects according to types of defects	Lectures, problem solving, Tutorials,	
2.8	Understand the effect of temperature and addition of impurities on the conductivity of semiconductors	Lectures, Tutorials, discussion	
<b>3.0</b>	<b>Competence</b>		
3.1	To present an oral explanation for a	opened essays on	Class activities

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	subject in the area.	selected topics	
3.2	To interact positively with colleagues in a group work	Interactive teaching sessions	Oral presentation on a group report
3.3	To contribute with colleagues to prepare and deliver a presentation and report of group work	Interactive teaching sessions	Discussion within a group
3.4	To summarize the literature and sources for an area in the course.	Guided reading of books and articles	Written Reports and summaries

## 2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework	4, 8, 11	15%
2	Midterm exam 1-2	6, 12	30%
3	Essay	11	5%
4	Final exam	15	50%

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

## E. Student Academic Counseling and Support

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

10 office hours are offered for students for individual consultations. Communications are available on-site, phone conversations, and chatting by social media.

## F. Learning Resources and Facilities

### 1. Learning Resources

<b>Required Textbooks</b>	Charles Kittel, Introduction to Solid State Physics, John Wiley & Sons, Inc., 8th ed., 2005.
<b>Essential References Materials</b>	Solid State Chemistry and its application" Anthony R. West, John Wiley and Son Ltd. 1985. U. Muller, "Inorganic Structural Chemistry", John Wiley & Sons, New York, 2nd ed., 2006.
<b>Electronic Materials</b>	<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> <a href="http://img.chem.ucl.ac.uk/sgp/mainmenu.htm">http://img.chem.ucl.ac.uk/sgp/mainmenu.htm</a> <a href="http://www.shef.ac.uk/.../solid-state-chemistry-applications-msc">www.shef.ac.uk/.../solid-state-chemistry-applications-msc</a> <a href="http://www.simplybooks.in/solid-state-chemistry-its-anthony-r-book..">www.simplybooks.in/solid-state-chemistry-its-anthony-r-book..</a> <a href="http://www.infibeam.com/.../solid-state-chemistry-its-applications/9...">www.infibeam.com/.../solid-state-chemistry-its-applications/9...</a> <a href="http://www.seas.upenn.edu/~chem101/sschem/solidstatechem.html">http://www.seas.upenn.edu/~chem101/sschem/solidstatechem.html</a>
<b>Other Learning Materials</b>	<b>Isidraw and Chemdraw and Chemoffice</b> <b>MS-Office Software</b> <a href="http://scholle.oc.uni-kiel.de/herges/modeling/gliederung.html">http://scholle.oc.uni-kiel.de/herges/modeling/gliederung.html</a> <a href="http://chem-faculty.ucsd.edu/trogler/GroupTheory224/Grouptheory.html">http://chem-faculty.ucsd.edu/trogler/GroupTheory224/Grouptheory.html</a> <a href="http://phycomp.technion.ac.il/~ira/types.html">http://phycomp.technion.ac.il/~ira/types.html</a>

## 2. Facilities Required

Item	Resources
<b>Accommodation</b> (Classrooms, laboratories, demonstration rooms/labs, etc.)	<ul style="list-style-type: none"> <li>• A classroom containing at least 45 seats and equipped with projector and Internet access (scheduled for 2 hours once a week).</li> <li>• A help session classroom containing at least 45 seats and equipped with projector and Internet access (scheduled for 1 hours every week).</li> </ul>
<b>Technology Resources</b> (AV, data show, Smart Board, software, etc.)	<ul style="list-style-type: none"> <li>• Common computer lab containing at least 25 computer sets.</li> <li>• High speed internet access.</li> </ul>
<b>Other Resources</b> (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	<ul style="list-style-type: none"> <li>• Isisdraw and Chemdraw and Chemoffice</li> <li>• Computer for individual students</li> <li>• Internet access</li> <li>• Networked laboratory systems</li> </ul>

## G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
<b>Course delivery (teaching methods and assessment methods)</b>	Student	Questionnaire
	Departmental Plan and curriculum committee; external reviewers	Reports and workshops
	Program Leader	Meetings
<b>Course contents (update)</b>	Departmental Plan and curriculum committee; external reviewers	Reports and workshops
<b>Quality of learning resources</b>	External reviewers	Reports

**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	Department counsel
Reference No.	1/22/142
Date	15-9-1442