Course Specification

(Postgraduate Programs)

Course Title:	**Nanomaterials and Hybrid Materials**
Course Code:	**CHM 6142**
Program:	Master of science in chemistry
Department:	Chemistry
College:	Science
Institution:	Imam Mohammad Ibn Saud Islamic University
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

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A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (3 Lectures, 0 Lab, 0 Tutorials)

2. Course type

A.	☐University	☐College	☐Department	☐Track
B.	☐Required		☒ Elective	

3. Level/year at which this course is offered: Level 2/Year 1

4. Course General Description:

The course will provide a theoretical description of the basic principles and fundamental properties of nanomaterials, and the physical and chemical properties of nanoscale structures. It will cover methods for designing and fabricating. The Second part is composed by an introduction to the basic chemical principles and characterization of hybrid materials; Interface-determined Materials, Hybrid Materials by the Sol–Gel Process, Organic Building Blocks, Structural Engineering, an overview of specific types of hybrid materials and some applications will be discussed.

5. Pre-requirements for this course (if any):

Advanced Physical Chemistry – CHM 6141

6. Pre-requirements for this course (if any):

None

7. Course Main Objective(s):

- **Improve their knowledge of the advanced information of nanostructured materials synthesis and fabrication.**
- **Recognize the reactivity of surface oxides.**
- **Develop their knowledge of the hybrid materials and nanocomposites.**
- **Be familiar with synthesis and characteristics hybrid materials with an overview of their potential applications.**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100 %
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)……**	0
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To recall knowledge of nanotechnology, nanomaterials categories and their synthetic methods.**	**K1. *Phy.*; K4. *Phy.***	▪ Five hours/week lectures. ▪ Self-study Home-exam.	▪ Regular Exams ▪ Assignments ▪ Short Quizzes ▪ Oral Discussion Participation.
1.2	**To state different characterization methods of Nanomaterials and their applications.**	**K2. *Phy.*; K3. *Phy.*; K4. *Phy.***	▪ Five hours/week lectures. ▪ Think to justify the different methods of characterization for nanomaterials, using available references (SDL) online. Open discussion	▪ Oral Discussion marks ▪ Literatures Survey ▪ Mini-seminar. ▪ Participation.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.3	**To describe the Hybrid Materials characterization and applications.**	**K3. *Phy.*; K4. *Phy.***	▪ Five hours/week lectures. Group Discussion using available references (SDL) online.	▪ *Midterm.* ▪ *Assignments.* ▪ Group Discussions. ▪ Literatures Survey ▪ Mini-seminar. ▪ Participation.
1.4	**To recognize the applications of Nanomaterials and Nanoscience.**	**K4. *Phy.***	▪ Five hours/week lectures. Group Discussion with mini-reports using available references (SDL) online.	▪ *Assignments* ▪ Open Discussions. ▪ Literatures Survey ▪ Mini-seminar. Participation.
2.0	**Skills**			
2.1	**To explain the concepts and principles of material, nanomaterials, and hybrid materials.**	**S1. *Phy.*; S2. *Phy.*; S4. *Phy.***	▪ Lectures activity ▪ Self-study. Think, and discuss nanomaterials and hybrid materials concepts.	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Open Discussions. ▪ Participation. Mini -seminar.
2.2	**To interpret nanomaterials and hybrid materials characterization and their correlation with synthetic methods.**	**S2. *Phy.*; S3. *Phy.***	▪ Suggest of examples hybrid materials characterization, achieving. ▪ Brainstorming. Self-study.	▪ Questions in Lectures. ▪ Participation ▪ Oral Discussion Short Quizzes.
2.3	**To illustrate the Nanostructured materials synthesis and fabrication.**	**S1. *Phy.*; S2. *Phy.***	▪ Lectures ▪ Oral Discussions. ▪ Brainstorming. Self-study	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Oral Discussion. Participation.
2.4	**To operate communication to Nanostructured**	**S2. *Phy.*; S3. *Phy.*; S4. *Phy.***	▪ Group Discussion and Assignments	▪ Oral Discussion.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Materials Synthesis and Fabrication, its applications, and impact in KSA industrial sector accompanying writing of mini- Reports, operating electronic mail, and Network in communicating with others.		▪ Suggest examples of nanostructured materials synthesis and fabrication, for evaluations, which will require reading, writing, and oral presentation in groups. Encourage students to use electronic mail to submit Home Exams and Assignments	▪ Quizzes, and Exams. ▪ Giving marks for Oral Discussion in Lectures. Marks given for Assignments.
3.0	**Values, autonomy, and responsibility**			
3.1	**To perform a scientific presentation, research, and work independently and integrate with a collaborated group, Using IT to acquire, analyze, and communicate information.**	**V1. *Phy*.**	▪ Brainstorming. ▪ Exercises ▪ Group Discussion. ▪ Team work.	▪ Oral Discussion. ▪ Group Discussion ▪ Assignments.
3.2	**To demonstrate his ability to the effectively collaboration and inter-professionalism in class discussions or team works, as well as independently.**	**V1. *Phy*.; V2. *Phy*.**	▪ Small Group tasks ▪ Open discussion at classroom. ▪ Office hour guiding. Group Presentation of mini-projects.	▪ Participation ▪ Homework's Mini-project(s).

C. Course Content:

No	List of Topics	Contact Hours
	Nanomaterials	
1.	***Nanomaterials:*** Synthesis strategies and formatting: single-crystal micro- or nanoscale powder**. Gel, colloid:** which method of synthesis and any formatting for any property, Inorganic polymerisation. The passage of the metal ion in solution at a solid oxide phase. **Condensation mechanisms of cations**: in solution are studied in detail to learn how to control the size, structure and morphology of nanoscale systems.	**12**
2.	***The reactivity of surface oxides:*** presented in conjunction with the adsorption and grafting phenomena to understand the functionalization of surfaces and the formation of organic-inorganic hybrid materials.	**4**
3.	***Nanomaterials and Nanosciences:*** the emergence of Nanosciences in future technologies, "Top-down": the future of computers; Moore's Law; mesoscopic field: example of the Aharonov-Bohm effect; **Coulomb blockade of single electron transistor** and; spintronics, "Bottom-up" principle of the scanning tunneling microscope; Atomic and molecular manipulation; **Chemistry atom by atom;** manipulating electronic waves: the Kondo effect, Features of molecular nanomachines, role of fluctuations in the operation. Exotic forms of carbon: fullerenes and nanotubes.	**10**
	Hybrid Materials:	
4.	Introduction to Hybrid Materials, Natural Origins, The Development of Hybrid Materials, **Definition:** Hybrid Materials and Nanocomposites, Advantages of Combining Inorganic and Organic Species in One Material.	**4**
5.	***Interface-determined Materials*:** The Role of the Interaction Mechanisms, Synthetic Strategies towards Hybrid Materials, **In situ Formation of Inorganic Materials**, Sol–Gel Process, Nonhydrolytic Sol–Gel Process, Sol–Gel Reactions of Non-Silicates,	**6**
6.	***Hybrid Materials by the Sol–Gel Process:*** Hybrid Materials Derived by Combining the Sol–Gel Approach and Organic Polymers, Formation of Organic Polymers in Presence of Preformed Inorganic Materials.	**3**
7.	***Hybrid Materials by Simultaneous Formation*:** of Both Components, Building Block Approach, Inorganic Building Blocks, **Organic Building Blocks, Structural Engineering**, Properties and Applications, Characterization of Materials	**6**
	Total	45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Class Activities (Open Discussion, Mini-reports, Oral Presentation, solving questions)	weekly	30 %
2.	Midterm Exam	9th week	30 %
3.	Final Exam	17 th week	40 %
4.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	***Nanomaterials for Environmental Protection*** **, Kharisov, B. I.; Kharissova, O. V., Rasika Dias**, H.V.;Wiley-VCH, 2014. ISBN: 978-1-118-49697-8 ***Bio-inorganic Hybrid Nanomaterials: Strategies, Synthesis Characterization and Applications*****, Euiz-Hitzky E.; Ariga K., Lvov Yu. (eds**.), Wiley-VCH, 2008. ISBN: 978-3-527-31718-9 ***Hybrid Materials: Synthesis, Characterization, and Applications*****, Kickelbick, G.;** Wiley-VCH, 2008. ISBN: 978-3-527-31299-3
Supportive References	None
Electronic Materials	• Nano Today • Nano Energy • Nano and Microstructural Design of Advanced Materials • Composites Science and Technology • Saudi Digital Library. Blackboard Multimedia associated with the text book and the relevant websites.
Other Learning Materials	• Blackboard • Multimedia associated with the text book and the relevant websites.

3. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology equipment (projector, smart board, software)	**The rooms are equipped with data show, Smart Board,** **WI-FI access.**
Other equipment (depending on the nature of the specialty)	**None**

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment 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 students assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory-GCC)	**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	
The extent to which CLOs have been achieved	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.

Assessment Areas/Issues	Assessor	Assessment Methods
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	Council of Chemistry Department
REFERENCE NO.	10 (No. 2/10)
DATE	21/04/1444- 15/11/2022