

**Kingdom of Saudi Arabia**  
**The National Commission for**  
**Academic Accreditation & Assessment**



**COURSE SPECIFICATION**  
**(Physical Chemistry 4, 402483-3)**  
**1435 / 1436 H**

## Course Specification

Institution: <b>Umm Al-Qura University</b>
College/Department: <b>Faculty of Applied Sciences / Chemistry Department</b>

### A. Course Identification and General Information

1. Course title and code: <b>Physical Chemistry 4, 402483-3</b>
2. Credit hours: <b>Three (2 theoretical + 1 practical) hrs.</b>
3. Program(s) in which the course is offered. (If general elective available in many programs indicate this rather than list programs)  <b style="text-align: center;">Industrial Chemistry</b>
4. Name of faculty member responsible for the course:  <b style="text-align: center;">Dr. Abd El ahman Salah Khder</b>
5. Level / year at which this course is offered: <b>7<sup>th</sup> level / 4</b>
6. Pre-requisites for this course (if any): <b>Physical Chemistry (3), 402383-3</b>
7. Co-requisites for this course (if any): <b>—</b>
8. Location if not on main campus: <b>—</b>

### B. Objectives

<p><b>1. Summary of the main learning outcomes for students enrolled in the course.</b></p> <p>At the end of this course the students will be fully aware of the basic concepts of surface chemistry including theories and equations and how they apply to catalysts in order to determine how to identify the surface properties (texturing) for solids.</p>
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### C. Course Description: (Note: General description in the form to be used for the Bulletin or Handbook should be attached).

1. Topics to be Covered		
<b>Topic</b>	No of Weeks	Contact hours
Surface tension and free surface energy.	<b>1</b>	<b>2</b>

Contact angle and work of adhesion and work of cohesion-Dupres equation	1	2
Equations of Kelvin, Laplace and Young.	1	2
Measurements of surface tension.	1	2
Surface films of insoluble substances on liquids-Gibbs equation.	1	2
Adsorption, adsorption of gases by solids.	1	2
Adsorption isotherms.	1	2
Theories of adsorption isotherms (Frundlish, Langmuir, Langmuir-Hinshelwood,.....)	1	2
Mid-term Exam	1	2
BET equation	1	2
Experimental methods of Gas adsorption for determining all parameters of surface properties including surface area, pore volume, pore area, pore size distribution,	1	2
Adsorption and Heterogeneous catalysis	1	2
Steps of heterogeneous catalysis- types of Poisonous-how to treat them.	1	2
Examples of heterogeneous catalysis mechanisms and kinetics.	1	2
Revision and final exam	1	2

### Laboratory Experiments Outline

Topics to be Covered		
<b>List of Experiments</b>	No of	Contact
The practical part includes the following experiments:	Weeks	hours
Study the adsorption of acetic acid on the surface of activated charcoal	2	6
Application of the equation of Freundlich on oxalic acid adsorption	2	6
Adsorption of oxalic acid and the application of Langmuir equation	2	6
Determination of heat of adsorption of acetic acid	2	6
Study of adsorption of gases and the application of BET equation	2	6
Study the catalytic dissociation of hydrogen peroxide	1	3
Determination of the surface tension of water.	1	3
Study the effect of temperature on the surface tension of a liquid	1	3
Final Exam	1	3

<b>2. Course components</b> (total contact hours per semester):			
Lecture: <b>28</b>	Tutorial: ---	Practical/Fieldwork/Internship: <b>42</b>	Other:---

**3. Additional private study/learning hours expected for students** per week. (This should be an average: for the semester not a specific requirement in each week)  
 - Sunday from 3-4 afternoon.

**4. Development of Learning Outcomes in Domains of Learning**

For each of the domains of learning shown below indicate:

- A brief summary of the knowledge or skill course is intended to develop;
- A description of the teaching strategies to be used in the course to develop that knowledge or skill;
- The methods of student assessment to be used in the course to evaluate learning outcomes in the domain concerned.

**a. Knowledge:**

**(i) Description of the knowledge to be acquired**

- Identify the different methods of measurement of surface tension and their applications on specific samples including petroleum products, surfactants.
- Learn how to apply the studied surface chemistry course on the application in the science of catalysis, especially non-homogeneous one.
- How to determine the surface area, pore volume, pore area of solids using various equations that have been studied.
- knowledge and understanding of some of the mechanical interactions as well as kinetics in some catalytic reactions.

**(ii) Teaching strategies to be used to develop that knowledge**

- Using open discussion to link the previous knowledge to the current and future topics and carry out discussion in small groups
- The students use the internet to prepare an essay about recent advances related to the course specifically on the application of surface chemistry in the science of catalysis and nanotechnology.

**(iii) Methods of assessment of knowledge acquired**

- Final written examinations and the middle of the semester.
- Oral exams.
- Simultaneous discussions.
- A systematic search in a subject of the decision

**b. Cognitive Skills****(i) Cognitive skills to be developed**

- The development of reverse thinking (back thinking) and to acquire the skill of the student training to link adsorption isotherms of different type to contrast material of specific texturing.
- The student acquires the skill to design a catalyst based on surface texturing of a given substance to apply it on a reaction and determine its course on the basis of a functional group.
- Acquire the skill of the student how to discuss the various theories of adsorption and to predict the application of any of them on a system.
- Design different ways to set the surface area of a substance.
- The student selects the appropriate mechanical interaction of a chemical reaction.

**(ii) Teaching strategies to be used to develop these cognitive skills**

- Using brain storming at the beginning of each lecture in order to stimulate the students towards the new topic of the course.
- Enhancing open discussion and generate debate during the lecture.
- To give some practical issues and to assign students to create a strategic plan to resolve.
- Encourage the transfer of learning using the tools of analysis in different applications and through the discussion of potential applications in correlated areas.
- Assign students tasks duties include tasks designed to open the application and analysis skills to predict and solve problems.

**(iii) Methods of assessment of students cognitive skills**

- Through assignments and homework.
- Measuring the extent of response to the mandates.

**c. Interpersonal Skills and Responsibility****(i) Description of the interpersonal skills and capacity to carry responsibility to be developed**

<ul style="list-style-type: none"> <li>- Take the personality and responsibility for their own learning.</li> <li>- Working effectively in groups and exercise leadership when appropriate.</li> <li>- Act ethically and consistently with high molar standards in personal and public forums.</li> <li>- Community linked thinking</li> </ul>
<p><b>(ii) Teaching strategies to be used to develop these skills and abilities</b></p> <ul style="list-style-type: none"> <li>- Encourage solving problems in groups during lecture.</li> <li>- Making open discussion about certain recent topic of the course.</li> </ul>
<p><b>(iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility</b></p> <ul style="list-style-type: none"> <li>- Homework and group reports.</li> <li>- Evaluate the results and analysis of laboratory experiments, and knowledge of the contribution of each individual in the interpretation through dialogue and discussion.</li> </ul>
<p><b>d. Communication, Information Technology and Numerical Skills</b></p>
<p><b>(i) Description of the skills to be developed in this domain.</b></p> <ul style="list-style-type: none"> <li>- Communicate effectively in oral and written forms.</li> <li>- Use information and communication technologies.</li> <li>- Use basic mathematical and statistical techniques</li> </ul>
<p><b>(ii) Teaching strategies to be used to develop these skills</b></p> <ul style="list-style-type: none"> <li>- Division of students into groups to search for a common point of research.</li> <li>- Commissioning the analysis and interpretation of research in the ring for discussion.</li> <li>- Access to samples of students to discuss the reports in the collective search.</li> </ul>
<p><b>(iii) Methods of assessment of students numerical and communication skills</b></p> <ul style="list-style-type: none"> <li>- Evaluation of results and analysis of laboratory experiments, and knowledge of the contribution of each individual in the interpretation through dialogue and discussion</li> </ul>
<p><b>e. Psychomotor Skills (if applicable)</b></p>
<p><b>(i) Description of the psychomotor skills to be developed and the level of performance required</b></p> <ul style="list-style-type: none"> <li>- Not required for this course.</li> </ul>
<p><b>(ii) Teaching strategies to be used to develop these skills</b></p> <ul style="list-style-type: none"> <li>- Not required for this course.</li> </ul>
<p><b>(iii) Methods of assessment of students psychomotor skills</b></p>

- Not required for this course

### 5. Schedule of Assessment Tasks for Students During the Semester:

Assessment	Assessment task (eg. essay, test, group project, examination etc.)	Week due	Proportion of Final Assessment
1	Class activities, Attendances and Duties	Throughout the Term	10%
2	Mid-Term Exam (s)	5-14	20%
3	Lab Activity and Final Exam on Lab	Throughout the Term	30%
4	Final Exam	End of the Term	40%
5	<b>Total</b>		<b>100%</b>

### D. Student Support

**1. Arrangements for availability of faculty for individual student consultations** and academic advice. (include amount of time faculty are available each week)

- Presence of faculty members to provide consulting and advice.
- Office hours: during the working hours weekly, and the creation of appropriate means.
- Academic Advising for students who need it, and taking into account the test member suitable for it.

### E Learning Resources

#### 1. Required Text(s):

- Memorandum of the basics of surface Chemistry (preparation material by professor).

#### 2. Essential References

- B. S. Bahl, Advanced Physical chemistry, S. Chand & Co., Ram Nagar, 1993, New Delhi, India.
- Surface Chemistry, Elaine M. McCash, 1st ed., Oxford University Press, 2001.

#### 3- Recommended Books and Reference Material (Journals, Reports, etc) (Attach List)

- Introduction to Surface Chemistry and Catalysis, Gabor. A. Samorgi, 2nd ed., L. Yimin, Wiley, 2010.

#### 4- Electronic Materials, Web Sites etc

- <http://en.wikipedia.org/wiki/Petroleum1>

- <http://www.chemhelper.com/>
- <http://www.chemweb.com/>
- <http://www.sciencedirect.com/>

**5- Other learning materials** such as computer-based programs/CD, professional standards/regulations

- Microsoft PowerPoint, Microsoft Word
- Videos on the chemistry of surfaces.
- Educational CD for surface Chemistry correlated with other themes.

**F. Facilities Required**

Indicate requirements for the course including size of classrooms and laboratories (ie number of seats in classrooms and laboratories, extent of computer access etc.)

**1. Accommodation** (Lecture rooms, laboratories, etc.)

- Classroom capacity (30) students.
- Processing Hall of appropriate educational means, including computers.

**2. Computing resources**

- Hall equipped with a computer and the Data Show and Television is urgently required.

**3. Other resources** (specify --eg. If specific laboratory equipment is required, list requirements or attach list)

- No other requirements

**G. Course Evaluation and Improvement Processes**

**1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching**

- Scheduled to complete the questionnaire calendar in particular.
- Focus group discussions with small groups of students.

**2. Other Strategies for Evaluation of Teaching** by the Instructor or by the Department

- Feedback and assistance from colleagues.
- Independent evaluation of the extent to which students of the standards.
- Independent advice to the duties and tasks.

**3. Processes for Improvement of Teaching**

- Workshops for the teaching methods.



- Continuous training for the faculty member.
- Revision of the proposed strategies.
- The provision of modern tools necessary for learning.
- Application of the means of e-learning.
- Exchange of internal and external experiences.

**4. Processes for Verifying Standards of Student Achievement** (eg. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution)

- Checking the samples of test papers, or student work which has been corrected by a faculty member.
- Exchange professors from different educational institutions on regular basis to correct samples of test papers.

**5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.**

- Consult with other professors teaches the same subject.
- Hosting a visiting professor to evaluate the subject.
- Workshops for teachers whom teach the same subject.
- Periodic review for teachers to modify the negatives contents in the subject.