Kingdom of Saudi Arabia

The National Commission for

Academic Accreditation & Assessment

COURSE SPECIFICATION

(Physical Chemistry 3, 402383-3)

1435 / 1436 H

Course Specification

Institution: **Umm Al-Qura University**
College/Department: **Faculty of Applied Sciences / Chemistry Department**

A. Course Identification and General Information

1. Course title and code: **Physical Chemistry 3, 402383-3**
2. Credit hours: **Three (2 theoretical + 1 practical) hrs.**
3. Program(s) in which the course is offered. (If general elective available in many programs indicate this rather than list programs) **Industrial Chemistry**
4. Name of faculty member responsible for the course: **Prof. Mohamed Ismail Mohamed Awad**
5. Level / year at which this course is offered: **6th level / 3**
6. Pre-requisites for this course (if any): **Physical Chemistry (2), 402382-3**
7. Co-requisites for this course (if any): **——**
8. Location if not on main campus: ——

B. Objectives:

1. Summary of the main learning outcomes for students enrolled in the course.

This course aim to :

- acquire basic knowledge of electrode potentials& electrochemical cells.
- differentiate between electrolytic and electrochemical cells.
- determine the solubility of sparingly soluble salts.
- explain the concepts of electrolytic and electrochemical cells.
- Understand the phenomenon of corrosion along with its basic reasons.
- understand how cells are used to measure electrode potentials by reference to the standard hydrogen electrode.
- know the importance of the conditions when measuring.
- know that standard electrode potentials can be listed as an electrochemical series.

- be able to use *E* values to predict the direction of simple redox reactions and to calculate the e.m.f. of a cell.
- be able to use given electrode data to deduce the reactions occurring in non-rechargeable and rechargeable cells and to deduce the e.m.f. of a cell
- understand the electrode reactions of a hydrogen-oxygen fuel cell and appreciate that a fuel cell does not need to be electrically recharged.
- How does the electrochemical reaction of corrosion work?
- What are the types of corrosion?
- Define methods of corrosion protection.
- What is passivity?

2. **Briefly describe any plans for developing and improving the course** that are being implemented (eg increased use of IT or web based reference material, changes in content as a result of new research in the field)

- Obsolete some topics will be dropped and more recent topics will be introduced.
- Number of lecture contact hours will be increased to 4 to allow a chance to introduce new subjects as electrode kinetics and cyclic voltammetry.

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

Topics	No of Weeks	Contact hours
Introduction to electrochemistry. Types of galvanic and electrolytic cell.	**1**	**2**
Cell reaction and electromotive force. Electrode potential and Nernst equation.	**1**	**2**
Electrochemical series,	**1**	**2**
Standard cell, Hydrogen electrode, Oxygen electrode.	**1**	**2**

Concentration cell.	**1**	**2**
Major Exam I	**1**	**2**
Application of electromotive force.	**1**	**2**
Batteries and fuel cell.	**1**	**2**
Types of overpotential and its measurements.	**1**	**2**
Electrical double layer.	**1**	**2**
Types of corrosion.	**1**	**2**
Major Exam II	**1**	**2**
Electrochemical kinetics of corrosion process.	**1**	**2**
Passivity: Definition, Theories, Action	**1**	**2**

Laboratory Experiments Outline

Topics to be Covered		
List of Experiments	No of Weeks	Contact hours
Daniel Cell, i) in presence of porous membrane ii) Salt Bridge	**1**	**3**
Concentration cell.	**1**	**3**
Galvanic precipitation.	**1**	**3**
Measurement of electromotive force.	**1**	**3**
Determine of the solubility product of sparingly soluble salt.	**1**	**3**
Electrochemical plating of metals from solution.	**1**	**3**
Calculations of some electrochemical parameters from Tafel Plots.	**1**	**3**
Calculations of the inhibition efficiency from corrosion current.	**1**	**3**
Determination of the corrosion rate of metal in acidic solution using weight loss method.	**1**	**3**
Calculation of the inhibition efficiency using weight loss method.	**1**	**3**
Determination of the corrosion rate of metal in acidic solution using thermometry method.	**1**	**3**
Calculation of the inhibition efficiency using thermometry method.	**1**	**3**
Review	**1**	**3**

Final Exam	**1**	**3**

2. Course components (total contact hours per semester):				
Lecture: **28 hours**	**Tutorial:** **Theoretical**	**Laboratory** **42 hours**	**Practical/Field work /Internship**	**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)

- 26 hours (2 hrs per week)

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3 hours/week (homework, take home exams and other assignments)

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 the 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

At the end of this course the students should know and understand the following:

- Describe The electrochemical cell in electrochemistry
- Describe the basic principles of galvanic and electrolytic cells
- Interpret the dependence of electrode potential on concentration.
- Compare batteries and fuel cells .
- Explain the types of overpotentials.
- Compare the models of double layer.

- Describe forms of corrosion.
- Compare methods of prevention of corrosion.
- Interpret the relevant chemical literature.

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

In class lecturing where current topics are interrelated the past and future topics. Basic principles of electrochemistry and applications are discussed with students.

(iii) Methods of assessment of knowledge acquired

- In-class short exams, majors and final exams
- Homework assignments
- Presenting the reports made on the case studies orally and in writing.
- Written Laboratory reports taking into consideration: presentation of results, data acquisition and analysis and the precision and accuracy of results.
- Laboratory performance (following the procedure, handling chemicals and equipment, adherence to safety regulations and time management).

b. Cognitive Skills

(i) Description of cognitive skills to be developed

- Compare galvanic and electrolytic cells.
- Demonstrate capability of choosing the appropriate cathode and anode to design a galvanic cell.
- Identify the unknown organic compounds by interpretation of combined spectra.
- Read, evaluate, and interpret numerical, chemical and general scientific information.
- Search and use the chemical literature in both printed and electronic formats.
- Work on potentiostats.
- Apply critical thinking and hypothesis-driven methods of scientific inquiry.

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

- Homework assignments on problem solving
- Case studies (literature applications on the various methods of analysis)
- Laboratory reports

(iii) Methods of assessment of students cognitive skills

- In-class quizzes.

- Major and final exams.
- Lab written reports.
- Performance in discussions during the lab sessions.

c. Interpersonal Skills and Responsibility

(i) Description of the interpersonal skills and capacity to carry responsibility to be developed

- Work effectively both individually and in teams in both classroom and laboratory.
- Apply the Kingdom's rules and regulations for safety and chemical waste.
- Demonstrate the ethical and professional standards articulated by professional organizations (e.g. the American Chemical Society).
- Understand the interrelationships among electrochemistry, technology, and global society, and of the societal implications of new developments in science.

(ii) Teaching strategies to be used to develop these skills and abilities

- Working independently and in groups towards some case studies. Collect literature reports , summarize, analyse and interpret the main findings.
- Manage resources, time and other members of the group
- Communicate results of work to others through written reports and oral presentations.

(iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility

- Individual performance within a group.
- Written presentations.
- Individual performance during the lab sessions.

d. Communication, Information Technology and Numerical Skills

(i) Description of the skills to be developed in this domain.

- Acquire a working knowledge of basic research methodologies, data analysis and interpretation.
- Formulate significant research questions, design experiments, use appropriate chemical instrumentation, and analyse and interpret data.
- Read, evaluate, and interpret numerical, chemical and general scientific information.
- Demonstrate effective written and oral communication skills, especially the ability to transmit complex technical information in a clear and concise manner.
- The ability to use computers for chemical simulation and computation, data acquisition, and database

usage.

- The ability to search and use the chemical literature in both printed and electronic formats.
- An understanding of the importance of performing accurate and precise experimental measurements and the ability to keep legible and complete experimental records.

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

- Homework assignments.
- Lab reports.
- Usage of computer and chemical software packages for data acquisition and analysis in the lab reports.

(iii) Methods of assessment of students numerical and communication skills

- Performance in the problem solving assigned in the homework.
- Evaluating the proficiency in communication, experimental design.

e. Psychomotor Skills (if applicable)

(i) Description of the psychomotor skills to be developed and the level of performance required

- Not applicable

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

- Not applicable

(iii) Methods of assessment of students psychomotor skills

- Not applicable

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	**Total**	**100%**

D. Student Support

1. **Arrangements for availability** of teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week)

- Office hours (6 hours per week + appointments)
- Help session (problem solving): 1 hour per week

E. Learning Resources

1. Required Text(s)

2. Essential References

- Electrochemistry Principles, Methods and Applications, Christopher M. A. Brett, Maria Oliveira Brett, Oxford University Press, 2005.

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

- Handbook of Electrochemistry, Cynthia Zosk, Elsevier, 2011.
- Handbook of Corrosion Engineering (Chinese), Pierre R. Roberge, McGraw-Hill, 2005.
- Corrosion Basics: An Introduction, Pierre R. Roberge, NACE International, 2006.

4- Electronic Materials, Web Sites etc

Web sites dedicated to Electrochemistry available on the internet.

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

- Power point presentations and other handouts posted on the WebCT for the students enrolled in the course.

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.)

- A classroom containing at least 50 seats.
- A chemical laboratory of at least 20 places.

2. Computing resources • Computer lab containing at least 20 computer sets. • Scientific calculator.
3. Other resources (specify --eg. If specific laboratory equipment is required, list requirements or attach list) - Availability of chemicals, reagents, glassware, analytical balances, equipment relevant to the experiments assigned for the whole course and safety setups.

G. Course Evaluation and Improvement Processes

1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching • Course evaluation by students • Faculty – students general gathering.
2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department • Peer consultation on teaching • Departmental council discussions • Discussions with the group of faculty teaching both the lab and lecture portions of the course.
3. Processes for Improvement of Teaching • Conducting workshops presented by experts on the teaching methodologies. • Periodical departmental revisions on its methods of teaching. • Monitoring of teaching activities by senior faculty members.
4. Processes for Verifying Standards of Student Achievement (eg. check marking by an independent member teaching staff of a sample of student work, periodic exchange and remarking of tests or a sample of assignments with staff at another institution) • Providing samples of all kind of assessment in the departmental course portfolio of the course • Assigning group of faculty members teaching the same course to grade same questions for various students. Faculty from other institutions are invited to review the accuracy of the grading policy • Conducting standard exams such as the American Chemical Society exams or others.
5. **Describe the planning arrangements for periodically reviewing course** effectiveness and planning for improvement. • The course material and learning outcome are periodically reviewed and the changes to be taken are

in the departmental and higher councils.

- The chairman of the department and faculty members take the responsibility.