



Kingdom of Saudi Arabia

**National Commission for Academic Accreditation &
Assessment**

COURSE SPECIFICATION

Kinetics and Reaction Mechanisms

Chem 336

Revised

Thursday, 23 October 2014

Course Specification

Institution:	King Khalid University
College:	College of Science
Department:	Department of Chemistry

A. Course Identification and General Information

1. Course title and code: Kinetics and Reaction Mechanisms (Chem 336)
2. Credit hours: 4
3. Program(s) in which the course is offered: Bachelor of Science
4. Name of faculty member responsible for the course: Dr. Morad Mustafa
5. Year or Level at which this course is offered: Year 3 (Level 6)
6. Pre-requisites for this course (if any): Chem 232
7. Co-requisites for this course (if any): None

8. Location (if not on main campus):

Main Campus

B. Objectives

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

- Understand the concepts of chemical kinetics principles.
- Determine the rate law parameters from the method of initial rates.
- Determine the rate law parameters using the integrated rate laws and statistical method.
- Use the Arrhenius equation to statistically determine the activation energy and the preexponential factor for a given reaction.
- Relate a reaction mechanism to the stoichiometry of the balanced chemical equation.
- Differentiate between types of reaction mechanisms.
- Apply the steady-state hypothesis to predict rate equations.
- Determine the effects of a rate-determining step on the overall rate.
- Differentiate between the catalysis reaction types.
- Understand the mechanisms of enzyme catalysis and inhibition.
- Determine the mode of inhibition.
- Determine the adsorption parameters for a reaction at the solid surface.

2. Briefly describe any plans for developing and improving the course that are being implemented.

- Diversify teaching methods, such as using projector, models, and showing animation for explaining difficult concepts.
- Continuous development to keep the contents of this course updated with the results of modern scientific research.
- Activation of more e-learning with this course by the University's website.

C. Course Description

Topics to be covered in the theoretical course.

Topics	No. of Weeks	Contact Hours
Course Introduction	0.5	1
Mathematical Background Review Coordinate Systems Logarithms and Exponentials Differentiation and Integration		
The Rates of Chemical Reactions Introduction Rates of Chemical Reactions Differential and Integrated Rate Laws First-Order Reaction Linear Regression Demonstration Second-Order Reaction Zero-Order Reaction Linear Regression Demonstration Temperature Dependence of Rate Constants	5	10 1 1 1 1 1 1 1
Exam Review	0.5	1
Exam 1	0.5	1
Examples of Reaction Mechanisms Opposing Reactions Parallel Reactions Consecutive Reactions Unimolecular Reactions		3
Catalysis Introduction Homogeneous Catalysis Enzymes	5	10 1 4
Exam Review	0.5	1
Exam 2	0.5	1
Heterogeneous Catalysis The Nature of Catalytic Sites on Solid Surfaces Adsorption and Desorption The Adsorption Isotherms Heats of Adsorption		5
Final Exam		

2. Course components (total contact hours per semester).

Lecture	Tutorial	Laboratory	Practical/Field work/Internship	Other
22	0	12	0	0

3. Additional private study or learning hours (expected for students per week).

- 2 hours for private study.
- 3 hour for homework assignment.

4. Development of Learning Outcomes in Domains of Learning.

a. Knowledge

(i) Description of the knowledge to be acquired

- The concept of rate law, rate constant, reaction order, half-life, activation energy, catalyst, reaction mechanism, molecularity, steady-state approximation, linear regression, homogeneous catalysis, heterogeneous catalysis, mode of inhibition, adsorption, fractional coverage, and adsorption isotherm.
- The kinetic equations for determining the rate law parameters at different reaction orders.
- Types of reaction orders.
- Reaction mechanisms for few basic reaction types.
- The equations used for adsorption parameters calculations.
- The mechanisms of enzyme catalysis and inhibition.

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

- Lectures.
- Tutorials.
- Dialogue and discussion.

(iii) Methods of assessment of knowledge acquired

- Two midterm and final exams that consist of the following types of knowledge questions (20% of final assessment): multiple choices, and true and false.
- Quizzes.

b. Cognitive Skills

(i) Description of cognitive skills to be developed

- Discussing the applications of kinetics chemistry in the learning process.
- The ability to distinguish reaction orders.
- Application of the principles of the kinetic chemistry to determine the rate law parameters at different reaction orders.
- Prediction of a rate law based on a reaction mechanism.
- The ability to distinguish the mode of inhibition.

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

- Explanations and examples given in lectures and practised under supervision in tutorials and laboratory tasks.
- Dialogue and discussion.
- Posting many examples and questions on the web page of the academic course.
- Introduce students to the available references in the library and websites specialized in this field.
- Showing films interested in the physical chemistry topics.

(iii) Methods of assessment of students cognitive skills

- Two midterm and final exams that consist of the following types of cognitive skills questions (60% of final assessment): multiple choices, true and false, and calculate.
- Homework assignments.
- Quizzes.

c. Interpersonal Skills and Responsibility

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

- Educating student about ethics of dealing with his colleagues, instructors, and supervisor.
- Teaching students the responsibility toward themselves and toward others.
- Working in group to make the students aware of responsibility.
- Instilling the self-learning character in the student.
- Decision-making.
- Independence.
- Work effectively.

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

- Distribution students to different groups in the practical lessons to acquire skills of dealing with everyone.
- Dialogue and discussion.

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

- Assessment of assignments includes portion of grade for effectiveness of investigation processes.
- Personal performance in classroom.

d. Communication, Information Technology and Numerical Skills

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

- The ability to communicate in English both orally and in writing.
- Enhancing the knowledge in information technology that will enable them to gather, interpret, and communicate information and ideas.
- Providing sufficient information about statistical and mathematical techniques that will enable them to apply in interpreting and proposing solutions.
- Communicate via the available electronic tools.
- The use of search engines across the Web.

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

- Student assignments that require good standards of use of IT, statistics, and mathematics techniques.
- Teaching by using the e-learning tools.

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

- Two midterm and final exams that consist of the following types of communication skills questions (20% of final assessment): multiple choices, true and false, calculate, and solve.
- Homework assignments.

e. Psychomotor Skills (if applicable)

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

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

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(iii) Methods of assessment of students psychomotor skills

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

Assessment	Assessment task	Week due	Proportion of Final Assessment
1	Quizzes	Weekly	5
2	Homework Assignments	Weekly	5
3	Exam 1 (Open book, closed book, or take away)	5	7.5
4	Exam 2 (Open book, closed book, or take away)	9	7.5
5	Laboratory Activities	16	25
6	Final Exam (Open book or closed book)		50

D. Student Support

1. Arrangements for availability of teaching staff for individual student consultations and academic advice.

- Office Hours: 4 hours
- Help Session: 1 hours

E. Learning Resources

1. Required Text(s)

- Physical Chemistry by Peter Atkins and Julio dePaula, 2009, 9th ed.

2. Essential References

- Principles of Chemical Kinetics by James E. House, 2007, 2nd ed.
- Chemical Kinetics and Reaction Dynamics by Paul L. Houston, 2006, 1st ed.
- Physical Chemistry by Thomas Engel and Philip Reid, 2005, 1st ed.

3. Recommended Books and Reference Material

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4. Electronic Materials

- E-Learning Deanship (<http://elc.kku.edu.sa/en/>).

5. Other learning material

- None.

F. Facilities Required

1. Accommodation

- A classroom containing at least 45 seats and equipped with projector and Internet access (scheduled for 2 hour twice a week).
- A help session classroom containing at least 45 seats and equipped with projector and Internet access (scheduled for 1 hour every week).

2. Computing resources

- Common computer lab containing at least 25 computer sets.
- High speed internet access.

3. Other resources

- Colored Printers.

G. Course Evaluation and Improvement Processes

1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching

- Confidential completion of standard course evaluation questionnaire.
- Focused group discussion with small groups of students.
- Review with the department chairman.

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

- Observations and assistance from colleagues.
- Independent assessment of standards achieved by students.
- Independent advice on assignment tasks.

3. Processes for Improvement of Teaching

- Workshops on teaching methods.
- Review of recommended teaching strategies.
- Periodical department revisions on its methods of teaching by experts on the teaching.

4. Processes for Verifying Standards of Student Achievement

- **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.**

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

- **Periodic revision of the course from concerned parties in the department and college, and improving it according to what is known in distinguished universities worldwide.**
- **Perform the necessary changes based on the feedback from the statistical analysis of the student grades.**
- **Perform the necessary changes based on the feedback from the workshops, conferences, and seminars recommendations.**
- **Perform the necessary changes based on the feedback from the experts in the field and faculty members.**