The University of Jordan

Accreditation & Quality Assurance Center

Course Syllabus

Aqueous Geochemistry
0305382

1	Course title	**Aqueous Geochemistry**
2	Course number	**0305382**
3	Credit hours (theory, practical)	3 hrs. (Theory)
	Contact hours (theory, practical)	3 hrs. (Theory / week)
4	Prerequisites/corequisites	
5	Program title	B. Sc. In Geology
6	Program code	0305 2
7	Awarding institution	The University of Jordan
8	Faculty	Science
9	Department	Geology
10	Level of course	3rd year B.Sc.
11	Year of study and semester (s)	
12	Final Qualification	B. Sc. In Geology
13	Other department (s) involved in teaching the course	None
14	Language of Instruction	English
15	Date of production/revision	

16. Course Coordinator:

Office numbers, office hours, phone numbers, and email addresses should be listed.

Office number : ***Geo 307***
Phone number (Office) : 009626 5355000 ext. 22254
Cell: :00962796906169
Office Hrs. : Sun, Tue, Thu , 10 - 11 am
: Mon , Wed , 9:30-11 pm
Email: mkuisi@ju.edu.jo

17. Other instructors:

Office numbers, office hours, phone numbers, and email addresses should be listed.

18. Course Description:

A survey of the basic concepts of groundwater geochemistry. In this course, you will obtain theoretical, laboratory skills required understanding how natural, and anthropogenic factors influence water composition on Earth's near-surface environments. We will primarily focus on fresh water (i.e. streams, lakes, and groundwater) and shallow geological environments. This course includes an overview of chemical principles that apply to

groundwater geochemistry, rock-water interactions, theoretical and practical applications in contaminated environments and groundwater modelling.

19. Course aims and outcomes:

A- Aims:

By the end of the course you will be able to:

- develop an understanding of basic principles of chemistry as it applies to geological and environmental processes,
- develop the requisite skills to apply these skills to solve environmental problems, and
- Learn how to make quantitative predictions about outcomes of chemical reactions that occur in context of geological processes.

B- Intended Learning Outcomes (ILOs):

- On successful completion of this course, you will be able to
- Critically understand processes related to geological processes
- Interpret the behavior of naturally complex environmental systems
- Critically analyze environmental data and explain your findings and conclusions to your peers
- Integrate various basic sciences (chemistry, biology, geology, etc.) and mathematical skills to solve multidisciplinary problems
- Collaboratively develop research projects
- Develop other ancillary skills:
  - Become familiar with journals and technical sources in subject area
  - Become proficient in conducting literature reviews
  - Improve your presentation and science writing skills
  - Learn how to use generic software (Excel, etc.) to analyze geochemical data

20. Topic Outline and Schedule:

Topic	Week	Instructor	Achieved ILOs	Evaluation Methods	Reference
Course Syllabus, Fundamental Chemical Principles (Chapter 1) a) Aqueous solutions and the properties of water b) Concentration and unit conversions c) Charge-balance error d) Graphical displays of water chemistry	1	Mustafa Al Kuisi	100%	Quiz on Ch. 1	Applied Chemical Hydrogeology. Keh (2001)
Chemical Equilibrium and Kinetics (Chapter 2) a) Activity b) Equilibrium constants c) Variation of K with temperature d) Activity-concentration relationships e) Complexes f) Kinetics	2, 3	Mustafa Al Kuisi	100%	Quiz on Ch. 2	Applied Chemical Hydrogeology Kehew, A.E. (2001
Acid-Base Reactions and the Carbonate System (Chapter 3) a) Strength of acids and bases b) Natural acid-base systems: the carbonate system 1) CO2 in water 2) Alkalinity c) Carbonate mineral equilibria 1) The common-ion effect 2) Incongruent dissolution of calcite and dolomite 3) Ionic strength effect	4, 5, 6	Mustafa Al Kuisi	100%	Quiz on Ch. 3	Applied Chemical Hydrogeology. Kehew, A.E. (2001

Mineral Weathering and Mineral Surface Processes (Chapter 4) a) Primary minerals and weathering products 1) Clay minerals 2) Oxides and hydroxides b) Dissolution processes and equilibria 1) Surface complexation and dissolution 2) Dissolution of quartz 3) Solubility of Al-bearing weathering products 4) Incongruent dissolution and activity diagrams 5) Silicate mineral weathering and lake acidification c) Sorption and ion exchange 1) Surface charge 2) Sorption isotherms 3) Adsorption of metal cations 4) Ion-exchange reactions 5) Ion exchange in natural and contaminated waters	7,8, 9	Mustafa Al Kuisi	100%	Quiz on Ch. 4		
Redox Reactions and Processes (Chapter 5) a) Electron transfer reactions 1) Oxidation number 2) Redox reactions 3) Electron activity 4) The standard hydrogen electrode 5) Determining Eh from redox couples b) Field measurement of Eh 1) Equipment and procedures 2) Pitfalls c) pE-pH (Eh-pH) diagrams d) Natural redox conditions in waters 1) TEAPs 2) Redox buffering	10, 12, 13	Mustafa Al Kuisi	100%	Quiz on Ch. 5		
Aqueous Organic Geochemistry (Chapter 6) a) Phase partitioning of organic compounds b) Classes of organic compounds and their occurrence in natural waters c) Humic substances	14, 15	Mustafa Al Kuisi	100%	Quiz on Ch. 6		

21. Teaching Methods and Assignments:

A number of problem sets will be assigned. These will be collected and will constitute a portion of your grade. Students are evaluated on in-class and take home assignments and class participation. Tests are used to document learning. Most tests are take-home, open-book tests because of the technicalities of the material. There are 8 labs in the course.

The Monday class of every two weeks will normally be a recitation section during which the problems will be discussed. The student will be expected to participate in these discussions. Similar problems can be expected on the quizzes and the final exam. Thus the student who waits until the last minute to do these problems, or simply copies down the instructor's or fellow student's solutions without attempting to do the problems, will have an excellent shot at an F.

22. Evaluation Methods and Course Requirements:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

Your grade for this course will be based on exams and assignments (e.g. problem sets, laboratory training). Most of the assignments will require a considerable effort outside of class time. Be sure you budget enough time for this course.

Your grade will be determined as follows:

Five Quizzes @ 2% each=	10%
Problem Sets =	10%
Mid-term Exam =	30%
Project or Research=	10%
Final Exam =	40%
Total	100%

23. Course Policies:

- Attendance Policy: attendance is mandatory. Class non-attendance usually results in poor grades.
- All students are expected to follow the policies of the Student Code of Ethics as outlined in the Student Handbook.
- During class lectures, please make sure that all cell phones and pagers are silenced or are in vibrate mode. If you need to answer an urgent call (except during an exam), please leave the class to speak on the phone.
- Please make sure to arrive at class on time, as entering late is a distraction to the students and instructor. Students arriving after an exam has already been passed out (without legitimate excuse) will lose 10 points on that exam, and will have less amount of time to finish the exam compared with the rest of the class.
- Cheating may, at my discretion, result in an ***F*** for the course. \

Grading will not necessarily be "on a curve." There is no expectation of what the average grade should be, nor what the grade distribution should look like. If everyone were to demonstrate outstanding understanding of all the material, then everyone deserves a grade of A (and I would be very happy to give each one of them)! I therefore encourage you to discuss the course material with each other to get the most out of the class.

Note: the points and percentages given are approximations and may vary slightly

Letter	Percentage
A	> 90
A-	85-89
B+	80-84
B	74-79
B-	70-74
C+	65-69
C	60-64
C-	55-59
D+	50-54
D	46-49
D-	41-45
F	40 and below

24. Required equipment:

25. References:

A- Required book (s), assigned reading and audio-visuals:

Applied Chemical Hydrogeology. Kehew, A.E. (2001) Prentice-Hall, Upper Saddle River, New Jersey

B- Recommended books, materials, and media:

1. Stumm, W. and Morgan, J.J. (1996) Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters. 3rd Edition. Wiley-Interscience, NY. THE BIBLE OF AQUEOUS GEOCHEMISTRY
2. Drever, J.I. (1997) The Geochemistry of Natural Waters: Surface and Groundwater Environments. 3rd Edition. Prentice-Hall, NJ.
3. Geochemistry, Groundwater, and Pollution (2005) Appelo and Postma, Balkema, 2nd edition.
4. Geochemical and Biogeochemical Reaction Modeling (2002) Bethke, Cambridge, 2nd edition.

26. Additional information:

Name of Course Coordinator: Mustafa Al Kuisi Signature: ---------- Date -20/08/2017

Head of curriculum committee/Department: ---------- Signature: ----------

Head of Department: ---------- Signature: ----------

Head of curriculum committee/Faculty: ---------- Signature: ----------

Dean: ---------- -Signature: ----------

Copy to:
Head of Department
Assistant Dean for Quality Assurance
Course File