



University of Manitoba  
 C.H.R. Faculty of Environment, Earth and Resources  
 Department of Environment and Geography

## ENVR4550 Aquatic Chemistry

### TABLE OF CONTENTS

COURSE DETAILS.....	2
INSTRUCTOR CONTACT INFORMATION.....	2
GENERAL COURSE INFORMATION.....	3
COURSE GOALS .....	3
USING COPYRIGHTED MATERIAL .....	3
RECORDING CLASS LECTURES .....	4
TEXTBOOK, READINGS, MATERIALS .....	4
COURSE TECHNOLOGY.....	4
CLASS COMMUNICATION.....	4
STUDENTS ACCESSIBILITY SERVICES .....	5
EXPECTATIONS: I EXPECT YOU TO .....	5
EXPECTATIONS: YOU CAN EXPECT ME TO .....	6
CLASS SCHEDULE.....	6
COURSE EVALUATION METHODS .....	7
GRADING .....	8
REFERENCING STYLE .....	8
ASSIGNMENT DESCRIPTIONS .....	8
ASSIGNMENT GRADING TIMES .....	9
ASSIGNMENT EXTENSION AND LATE SUBMISSION POLICY .....	9

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## COURSE DETAILS

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<b>Course Title &amp; Number:</b>	Aquatic Chemistry (ENVR4550)
<b>Number of Credit Hours:</b>	3
<b>Class Times &amp; Days of Week:</b>	8:30-11:15; Wednesdays
<b>Location for classes:</b>	500A Machray Hall
<b>Course website:</b>	<a href="http://home.cc.umanitoba.ca/~wangf/ac">http://home.cc.umanitoba.ca/~wangf/ac</a>
<b>Pre-Requisites:</b>	ENVR2550 or approval by the Department Head

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## Instructor Contact Information

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<b>Instructor(s) Name:</b>	Dr. Feiyue (Fei) Wang
<b>Preferred Form of Address:</b>	Dr. Wang
<b>Office Location:</b>	588 Wallace Building
<b>Office Hours or Availability:</b>	13:00-15:00, Wednesdays You can also drop by my office anytime and I will see you if I am not busy Email me for an appointment if you need to talk to me for more than 15 min
<b>Office Phone No.</b>	204-474-6250
<b>Email:</b>	<a href="mailto:feiyue.wang@umanitoba.ca">feiyue.wang@umanitoba.ca</a> <i>I will typically return email within 24 hrs</i>
<b>Contact:</b>	By email or in person

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## Course Description

(Formerly 128.455) An examination of biogeochemical processes affecting the distribution, speciation and bioavailability of chemical substances in the aquatic environment. The theoretical basis for the chemical behaviour of natural water systems is discussed, as well as the description of the processes involved in wastewater treatment. Not to be held with CHEM 4550 (002.455). Prerequisite: ENVR 3550 (128.355) (C), or (002.355) (C), or CHEM 3590 (C), or (002.347) (C), or permission of department head.

## General Course Information

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This course deals with processes affecting the circulation, speciation, transformation, and bioavailability of chemical species in the aquatic environment. The course draws primarily on the principles of physical chemistry; however, a fundamental understanding of geology and biology will be very helpful. This course does not have a lab section. Students are strongly encouraged to take the course "Instrumental Analysis" (CHEM3590) which introduces important analytical techniques for environmental studies.

## Course Goals

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The objective of this senior-year course is to develop a theoretical basis for the understanding of transport and transformation of chemicals in natural waters, as well as in engineered wastewater treatment facilities. This course is ideal for students who are interested in a deep understanding of water quality of freshwater systems and wastewater treatment, in seeking employment in environmental/geoengineering consulting firms or government agencies, and in pursuing further graduate studies in the broad fields of environmental chemistry, ecotoxicology or environmental engineering.

## Using Copyrighted Material

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Please respect copyright. We will use copyrighted content and software in this course. I have ensured that the content I use is appropriately acknowledged and is copied in accordance with copyright laws and University guidelines. Copyrighted works, including those created by me, are made available for private study and research and must not be distributed in any format without permission. Do not upload copyrighted works to a learning management system (such as UM Learn), or any website, unless an exception to the *Copyright Act* applies or written permission has been confirmed. For more information, see the University's Copyright Office website at <http://umanitoba.ca/copyright/> or contact [um\\_copyright@umanitoba.ca](mailto:um_copyright@umanitoba.ca).

The lecture slides will be posted on the course website and password-protected. The password will be provided to students in class; please do not distribute the password to anyone who is not registered in the course.

The MINEQL+ software will be provided to the students, free of charge, under a teaching license granted to Dr. Feiyue Wang. Please use the software for your learning purpose only, and do not distribute to anyone without permission from Dr. Feiyue Wang.

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## Recording Class Lectures

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Prof. Feiyue Wang and the University of Manitoba hold copyright over the course materials, presentations and lectures which form part of this course. No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without permission from Dr. Feiyue Wang. Course materials (both paper and digital) are for the participant's private study and research.

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## Textbook, Readings, Materials

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Optional Textbooks:

Stumm W. and Morgan J.J. 1996. Aquatic Chemistry, 3rd Edition, Wiley.

Jensen J. 2003. A Problem-Solving Approach to Aquatic Chemistry. Wiley.

Additional material will be handed out in class or posted at the course website.

Be aware of copyright laws when using readings.

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## Course Technology

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It is the general University of Manitoba policy that all technology resources are to be used in a responsible, efficient, ethical and legal manner. The student can use all technology in classroom setting only for educational purposes approved by instructor and/or the University of Manitoba Disability Services. Student should not participate in personal direct electronic messaging / posting activities (e-mail, texting, video or voice chat, wikis, blogs, social networking (e.g. Facebook) online and offline "gaming" during scheduled class time. If student is on call (emergency) the student should switch his/her cell phone on vibrate mode and leave the classroom before using it. (©S Kondrashov. Used with permission)

Much of the chemical equilibrium calculations will be done using a computer software MINEQL+. A learning version of the software will be distributed to each student to be installed in their personal computer, preferably a laptop (As mentioned above, the MINEQL+ license is granted to Dr. Feiyue Wang for teaching purpose only; do not distribute the software to anyone without permission from Dr. Feiyue Wang). It is advised that the student brings the laptop to each class as there will be interactive exercises. If a student does not own a laptop, it is his/her responsibility to arrange access to one (e.g., sharing with a classmate).

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## Class Communication

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The University requires all students to activate an official University email account. For full details of the Electronic Communication with Students please visit:

[http://umanitoba.ca/admin/governance/media/Electronic Communication with Students Policy - 2014 06 05.pdf](http://umanitoba.ca/admin/governance/media/Electronic_Communication_with_Students_Policy_-_2014_06_05.pdf)

Please note that all communication between myself and you as a student must comply with the electronic communication with student policy

([http://umanitoba.ca/admin/governance/governing\\_documents/community/electronic\\_communication\\_with\\_students\\_policy.html](http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html)). You are required to obtain and use your U of M email account for all communication between yourself and the university.

## Students Accessibility Services

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### Student Accessibility Services

If you are a student with a disability, please contact SAS for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

*Student Accessibility Services* <http://umanitoba.ca/student/saa/accessibility/>

520 University Centre

204 474 7423

[Student\\_accessibility@umanitoba.ca](mailto:Student_accessibility@umanitoba.ca)

## Expectations: I Expect You To

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- Visit the course website at least once per week
- Regularly attend the class. I will not record your attendance, but you will find it is extremely challenging to do well in the course without regular attendance.
- Be curious
- Actively participate in the discussion
- Not to be disruptive
- Be respectful to others. See [Respectful Work and Learning Environment Policy](#).

### Academic Integrity:

The University of Manitoba regard acts of academic dishonesty in quizzes, tests, examinations, laboratory reports or assignments as serious offences and may assess a variety of penalties depending on the nature of the offence. Acts of academic dishonesty include, but are not limited to bringing unauthorized materials into a test or exam, copying from another individual, using answers provided by tutors, plagiarism, and examination personation. Penalties that may apply, as provided for under the University of Manitoba's Student Discipline Bylaw, range from

a grade of zero for the assignment or examination, failure in the course, to expulsion from the University. The Student Discipline Bylaw may be accessed at:

[http://umanitoba.ca/admin/governance/governing\\_documents/students/student\\_discipline.html](http://umanitoba.ca/admin/governance/governing_documents/students/student_discipline.html)

**Specific course requirements for individual work and group work include:**

- (i) Group projects are subject to the rules of academic dishonesty;
- (ii) Group members must ensure that a group project adheres to the principles of academic integrity.
- (iii) Students should also be made aware of any specific instructions concerning study groups and individual assignments;
- (iv) The limits of collaboration on assignments should be defined as explicitly as possible; and
- (v) All work is to be completed independently unless otherwise specified. =

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### **Expectations: You Can Expect Me To**

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A large part of my teaching practice includes the use of well-organized PowerPoint slides – they will be posted on the course website before or shortly after each lecture. I also use many practical and often real-world questions in class. I expect students to respond but I do not expect perfection.

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### **Class Schedule**

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The tentative schedule below is subject to change at the discretion of the instructor and/or based on the learning needs of the students. Most updated schedule is posted on the course website.

Date	Lecture Slides	Readings	Assignment
<b>I. Preparation</b>			
Jan. 18	1. Introduction to and Modeling in Aquatic Chemistry	Dr. M. Chaplin's water site Robert, 2001. Science 293, 1056-1058 Davies et al., 1964. Nature 203, 1110-1115	
Jan. 25	2. Chemical Thermodynamics & Kinetics	Any textbook on chemical thermodynamics and kinetics	
Feb. 01	3. Solution to Chemical Equilibrium Problems	MINEQL+ Home Page M/NTEQA2 Home Page PHREEQC Home Page	Assignment 1
<b>II. Homogeneous Aqueous Reactions</b>			
Feb. 08	4. Acid-Base Reactions	pH & related terms from IUPAC	
Feb. 15	5. Complexation Reactions	International Humic Substances Society (IHSS) Windermere Humic Substance Model (WHAM)	Term Paper Instructions
Feb. 22	<b>Mid-Term Break; NO CLASS</b>		
Mar. 01	6. Redox Reactions		
<b>III. Interfacial Processes</b>			
Mar. 08	7. Air-Water Interface		Assignment 1 is due
Mar. 15	8.1 Water-Particle Interface (I)	Excerpt from Course Note 2009	Solution to Assignment 1
Mar. 22	8.2 Water-Particle Interface (II)	Excerpt from Course Note 2009	Assignment 2
Mar. 29	9. Water-Biota Interface		
<b>IV. Putting Pieces Together</b>			
Apr. 05	10. Modeling the Transport and Transformation of Chemical in the Aquatic Environment		
Apr. 12	11. Special topic: Cryospheric chemistry		
Apr. 19	Term Paper Presentation		Assignment 2 is due
TBA	Final Exam		Solution to Assignment 2 Term paper is due!

## Course Evaluation Methods

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The dates below are subject to change at the discretion of the instructor and/or based on the learning needs of the students. Most updated dates are posted on the course website.

Due Date:	Assessment Tool	Value of Final Grade
8:30 am, Wed., Mar. 08	Assignment 1	15%
8:30 am, Wed., Apr. 19	Assignment 2	15%
8:30 am, Wed., Apr. 19	Term paper (presentation)	10%
Day of final exam	Term paper (report)	20%
To be announced	Final exam	40%

## Grading

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Indicate your grading scale. A sample is given below that you can adjust to your course expectations.

Letter Grade	Percentage out of 100	Grade Point Range	Final Grade Point
A+	90-100	4.25-4.5	4.5
A	80-89	3.75-4.24	4.0
B+	75-79	3.25-3.74	3.5
B	70-74	2.75-3.24	3.0
C+	65-69	2.25-2.74	2.5
C	60-64	2.0-2.24	2.0
D	50-59	Less than 2.0	1.0
F	Less than 50		0

## Referencing Style

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Assignments should use the Environmental Science and Technology (ES&T) reference style. Consult the journal for details.

## Assignment Descriptions

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**Assignments #1 and #2:** The two assignments include a set of questions that often require a substantial amount of time to complete. **DO NOT WAIT UNTIL THE NIGHT BEFORE IT'S DUE!**

Some calculations questions can be solved by hand or using MINEQL+; either way is acceptable. Show details for full credit.

The assignments should be submitted electronically or in hard copy (handwritten or print).

**Term paper:** You will be selecting a topic to write a term paper. You are advised to thoroughly search the related literature, carry out your own calculation/data interpretation, write and submit a complete report, and make a PowerPoint presentation in class. The report should include an abstract, introduction, the main report, conclusion and a complete list of references cited in the report. Wherever applicable, you should discuss detailed chemical transformation and transport across the air/water/sediment/biota interfaces, with examples showing speciation across environmentally relevant pH and pe ranges (e.g., pC-pH and/or pe-pH diagrams made by yourself). I am not looking for lengthy reports; ~5000 words plus graphs/tables/references would be the ballpark.

The term paper should be submitted electronically in Word format.

**Final exam:** Final exam will cover the topics taught during the entire semester, focusing on major concepts and principles.



## **Assignment Grading Times**

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The graded assignments will typically be returned to the students within two weeks.

## **Assignment Extension and Late Submission Policy**

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The submission is due by mid-night of the specified deadline date. Late assignments will be deducted 10% per day unless you have requested and obtained an extension from me.