Spring 2019 Syllabus **Revised 01/13/2019**

MSL 660: Chemical Oceanography
Class meeting times: T,Th 09:45-11:15
Location: 138 Irving II

3 credits
Prerequisites: Graduate standing

Instructor:

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Office Hours: M,W 1:30-3:00 or by appointment

Course Description: An integrated study of the chemical, biological and physical processes that determine the distribution of chemical variables in the sea. Topics include biogeochemical cycles and the use of tracers to follow these complex chemical cycles. The chemistry of carbon is considered in detail. Interactions with the atmosphere and lithosphere (including implications of the mid-ocean ridge vent system to ocean chemistry) are examined. Chemical oceanography is one of the four major fields of oceanography. We will examine the ocean as a chemical system by covering fluxes across boundaries with the land, atmosphere, sediments and hydrothermal vents, and by focusing on the internal cycling of elements driven by biological and physicochemical processes. Chemical oceanography is an essential part of the interdisciplinary knowledge necessary to understand the ocean. Students will be evaluated based on class participation, two homework assignments, a review paper and oral presentation, two midterm exams, and a final exam. Cross-listed with CHEM F660; Stacked with MSL F461

Course Goals: The ocean is central to the climate system and the natural resources of our planet. The goal of the course is to provide ocean literacy that will enable understanding of the ocean as a system and its intrinsic role in the biogeochemical cycling of elements. Additional goals include the improvement of critical thinking, and the improvement of written and oral science communication skills.

Learning Objectives:
1. Understand the factors controlling input, output, and internal cycling of the chemical components in the ocean.
2. Identify physical, geological, chemical, and biological controls affecting the distribution and behavior of chemical species.
3. Become familiar with oceanographic approaches to chemical data collection and interpretation.
4. Understand and think critically about recent research in the field.

Expected preparation for the course: Undergraduate degree in science, or a background that includes similar undergraduate courses, is necessary. Competence in algebra is necessary; introductory calculus and differential equations are useful for some topics but are not required. One year of general chemistry and biology at the college level are necessary; organic chemistry, inorganic chemistry and biochemistry are helpful. Biological and physical oceanography are also helpful. If you have not taken a background course described as “helpful”, you will probably benefit from doing some extra reading to familiarize yourself with the basics. For example, an introductory general oceanography text will be useful for students who have not had this background.

Instructional Methods: Various instructional methods will be used during the course, including lectures, reading assignments, class discussion, hands-on practice through homework assignments, literature research, and student presentations**.** BlackBoard will be used to distribute class information, updates and changes. Distance delivery through video conferencing will be available to students located outside Fairbanks.

Note: This is a stacked 400/600 level course. The material covered will be the same for both versions of the course, but the grading will differ. To receive full credit, graduate students will be required to 1) answer all the parts of homework and exam questions; 2) make three oral presentations on assigned reading; 3) lead class discussion on assigned readings; 4) by the end of the course be able to understand and evaluate recent chemical oceanography research; and 5) attend and participate in class. While undergraduate level students will be required to 1) answer only the first three parts of homework and exam questions; and 2) attend and participates in class. Homework and exam questions will be written as 4-part questions. Answering the 4th part of each question will require greater understanding of the topic and scientific sophistication expected of students at the graduate level.

Grading:

Class Participation	7 %
Homework (2 Assignments)	24 %
Oral presentations (4 papers)	24%
Midterm 1	15 %
Midterm 2	15 %
Final Exam	15%

>90 %	=	A
80-89 %	=	B
70-79 %	=	C
60-69%	=	D
< 59 %	=	F

Grades for each category will be weighted as shown above to obtain an overall grade from all possible class points. There will be no extra credit assignments. Your overall grade will be rounded to the nearest whole percentage before final grades are assigned. Only whole letter grades will be assigned (no plus (+) and minus (-) grading system).

Text: Pilson, Michael E. Q. 2013. *An Introduction to the Chemistry of the Sea.* 2nd Edition, Prentice Hall.
Assigned readings from other texts/articles will be provided in class or via the library.
Additional texts you might find useful:

- Sarmiento, J. L., and N. G. Gruber. 2006. *Ocean Biogeochemical Dynamics.* Princeton University Press.
- Chester, R. and T. Jickells. 2012. *Marine Geochemistry, Third Edition*. Wiley, John & Sons, Inc.
- Libes, Susan. 2009. *An Introduction to Marine Biogeochemistry*, 2nd Edition, Academic Press

Course Policies: Lecture **attendance** and active **participation** in class is expected from all students. If you must be absent due to illness, conference travel, field work, or other important reasons, please notify the instructor in advance (if possible) and arrange to make up missed material or assignments.

Lack of academic integrity including plagiarism is not acceptable and will result in a failed grade. Consult the UAF Student Conduct guidelines and expectations found on line.

Two **homework assignments** will be given. Homework sets consist of multi-part questions that include a combination of quantitative and qualitative problems. Homework sets are design to enhance your understanding of complex oceanographic processes and to provide hands-on experience in calculating chemical parameters. Collaboration among students is encouraged. However, each student is expected to submit their own work. Late homework assignments will not be accepted, unless arrangements have been made in advance with the instructor.

Oral presentations of current peer-reviewed articles (4) will be given throughout the semester. Student groups will choose papers/dates in advance, and will be responsible for presenting the main findings of the paper to the class (~ 10 minutes), and leading the discussion (~10 minutes). The number of students in each group will depend on the number of students enrolled in the class.

Exams. There will be 2 midterms. The second will be a take home exam; the first will be completed during the normal class period. The final exam will be administered during its scheduled time (30 April, 8-10am). Exams will require short-essay, diagramed answers and problem solving. The first midterm and final exams will be closed-book. The final exam will emphasize the material covered after the second midterm, but students are required to draw upon knowledge obtained throughout the course.

Support and Disability Services: At UAF, the Office of Disability Services (203 WHIT; 474-5655; TTY 474-1827; fydso@uaf.edu) ensures that students with physical or learning disabilities have equal access to the campus and course materials. If you have specialized needs, please contact this office or the instructor to make arrangements.

Date	Topic	Reading	Assignment
1/15	Introduction, ocean circulation review	Pilson, Chapter 1	
1/17	Seawater properties The hydrological cycle and weathering	Pilson, Chapter 2, Libes Chapter 2, section 2.2	
1/22	Box Models and Mass balance		
1/24	Salinity and Major Ions	Pilson, Chapters 3 & 4 **TEOS 10 Primer**	Paper discussion (Ana)
1/29	Radioactive Clocks	Pilson, Chapter 10, Appendix I	HW#1 Assigned
1/31	Atmosphere-seawater interface	Pilson Chapter 5 & 13.2	
2/5	Gas exchange	Pilson Appendix D, **Wanninkhof et al. (2009)**	Paper discussion
2/7	Oxygen and redox reactions	Libes, Chapter 7; Pilson, Section 12.1	HW#1 Due
2/12	**MID-TERM EXAM #1**	Through Redox reactions	
2/14	Inorganic carbon chemistry I	Pilson, Chapter 7 & App. E-G	
2/19	Inorganic carbon chemistry II	**Doney et al. (2008)**	Paper discussion
2/21	Macronutrients	Pilson, Chapter8	
2/26	Primary Production	Pilson, Section 11.2 **Epply and Peterson (1979)**	Paper discussion
3/5	Dissolved Organic Carbon	Pilson 11.5-11.7 Hansel et al. (2009); **Hansel (2013)**	Paper discussion (Ana)
3/7	Trace Elements	Pilson, Chapter 9	
3/9	Iron Fertilization & GEOTRACES	**Boyd et al., 2007**	Paper discussion
3/11 to 3/15*	**SPRING BREAK**		
3/19*	**MID-TERM EXAM #2 (no class)**	Through Ocean Fertilization	
3/21	Particle flux	Pilson, Sections 11.1-11.3 **Martin et al., (1997)**	HW#2 Assigned Paper discussion
3/26	Phosphorous and Silicon Cycles	Paytan and McLaughlin, 2007; Libes Chapter 16	
3/28	Nitrogen cycle I	Libes Chapter 24	
4/2	Nitrogen cycle II	**Sohm et al. (2011)**	HW#2 Due Paper discussion
4/4*	Marine carbon cycle I (Recorded)	Pilson Chapter 7; Libes Chapter 26	
4/09*	Marine carbon cycle II (Recorded)		
4/11	Sediment burial and diagenesis	**Riebesell et al. (2009)** Pilson Section 13.4; Libes Chapter 12	Paper discussion
4/16	Hydrothermal systems	Pilson Section 13.3, 13.5	
4/18	Overflow and undergraduate presentations		
4/23*	Sea Ice Biogeochemistry (Recorded)	“SeaIce” book Chapter 12	
4/25*	No Class Review on your own		
4/30	FINAL EXAM	Since Particle Flux	