

**OCN 310L: Global Environmental Change Laboratory****Marine Science Building, Room 307/314, Wed 1:30–4:00 pm****Instructor:** Richard E. Zeebe**TA:** Hyang Yoon, MSB 409, Email: [hyangy@hawaii.edu](mailto:hyangy@hawaii.edu)**Textbook:** Consider a spherical cow: A course in environmental problem solving, John Harte, University Science Books, Sausalito, CA, 1988. ISBN: 0-935702-58-X.**Grading:**

Weekly homework assignments: 30%

Homework presentation and class participation: 40%

Draft, paper and oral presentation: 30%

**No midterm! No final!****Rules:**

In fairness to other students, draft or paper turned in 1 and 2 days late will receive a grade corresponding to 2/3 and 1/3 of the points scored, respectively. After 2 days, zero credit will be given. Homework not turned in before class receives 0 points. These rules apply unless there is a *documented* reason such as medical emergency or funeral.

In this class you will develop and improve skills in working out strategies and ideas how to quantitatively solve problems. The topics will focus on Earth's environment. Your challenge will be to develop concepts and approaches to various problems and finally provide useful solutions to them (calculating sophisticated, highly accurate answers will not be the goal, rather useful approaches and reasonable values will be required). This is sometimes not a trivial task and you should **anticipate to spend a considerable amount of time on your homework**, but – as the famous physicist Richard Feynman has put it – you will have "the pleasure of finding things out"!

If necessary, contact Hyang regarding your homework – but only after in-depth consideration of the problem and with a preliminary idea or a precise question.

The first part of the class will be concerned with problems and exercises of the textbook. Every week homework will be assigned

and turned in before class the week after. The homework will be discussed in class and every week some of you will present their solutions to the other students. The presentation will rotate and at the end of the semester each student will have presented approximately the same number of exercises.

The second part of the class will be concerned with developing and using numerical tools for quantitative problem solving. The scientific topic will focus on phosphorus cycling in the ocean. You will develop a numerical algorithm (in groups of two) to solve the equations of a box model of the ocean's phosphorus cycle (Toggweiler, 1999). The software used for this application will be MATLAB (**bring a memory key to every class in order to save your files!**). After development of the base model, you will choose a project which will serve as the subject of your paper and oral presentation. A typical project will require changes to the existing numerical code in order to perform a sensitivity study or tackle a related/advanced problem.

### Tentative Schedule

#### Aug 23

Introduction

Chapter I.1–I.5

Homework:

Related exercises, to be assigned

Read p. 21–33, Chapter II.1–II.4

#### Aug 30

Chapter II.1–II.4

Homework:

Related exercises, to be assigned

Read p. 34–44, Chapter II.5–II.7

#### Sep 06

Chapter II.5–II.7

Homework:

Related exercises, to be assigned

Read p. 45–58, Chapter II.8–II.10

#### Sep 13

Chapter II.8–II.10

Homework:

Related exercises, to be assigned  
Read p. 95–108, Chapter IIC (II.19–II.20)

**Sep 20**

Introduction to chemical equilibria  
Chapter II.19–II.20  
Homework:  
Related exercises, to be assigned  
Read p. 111–113, 138–149, Chapter (II.22, III.4)

**Sep 27**

Non-steady state box models and carbonate chemistry  
Chapter II.22, III.4  
Homework:  
Related exercises, to be assigned  
Read MATLAB Intro

**Oct 04**

Introduction to MATLAB  
Homework:  
Solve analytically  $dy/dt = \lambda y, y(0) = y_0$

**Oct 11**

Solve numerically  $dy/dt = \lambda y, y(0) = y_0$   
Develop routines for base model (PO<sub>4</sub> in 3-box model)  
Homework:  
Work on model/Read project description

**Oct 18**

Develop routines for base model (PO<sub>4</sub> in 3-box model)  
Discussion/assignment of projects  
Homework:  
Work on model/draft paper

**Oct 25**

Finalize routines for base model (PO<sub>4</sub> in 3-box model)  
Project model experiments  
Homework:  
Work on model/draft paper

**Nov 01**

Project model experiments  
Work on draft paper

Homework:  
Draft paper

**Nov 08**

Project model experiments  
Work on draft paper  
Homework:  
Draft paper

**Nov 15**

Project model experiments  
Work on draft paper  
Homework:  
Draft paper

*Thursday, Nov 16, 01:00 pm: Draft paper due for review*

→ *Mailbox, MSB 502*

**Nov 22**

Discussion of reviewed draft paper  
Work on model/final paper in class  
Homework:  
Work on model/final paper  
Prepare oral presentation

*Wednesday, Nov 29, 01:30 pm: Final paper due*

**Nov 29****Oral presentations**

Homework:  
Read p. 59–73, Chapter II.11–II.13

**Dec 06**

Chapter II.11–II.13