

UNIVERSITY of TORONTO at SCARBOROUGH
Department of Physical & Environmental Sciences

January 2023
Oceanography EESC19

The world's oceans constitute more than 70 % of the earth's surface environments. This course will introduce students to the dynamics of ocean environments, ranging from deep ocean basins, to marginal seas, to the coastal ocean. The physical nature of ocean systems, their origins, and their importance in the global hydro-climatic system will be examined first; we will then focus on the primary physical mechanisms that control ocean dynamics.

Students who have completed introductory calculus (MATA30/31 and MATA36/37) can expect to be well-prepared, but those without are strongly advised to consult the Math and Statistics Learning Centre (<http://www.utoronto.ca/mslc/>) for additional assistance. Completion of first year physics would also be an asset.

Instructor: Prof. Mathew Wells Email: m.wells@utoronto.ca

The course will be organized around: (a) a 2-hour lecture each week; in some weeks (b) a 1-hour tutorial/ office hours where the assignments will be discussed.

I will be posting PPT files of the lectures on Quercus, usually the day before classes. During the pandemic the lectures will be delivered via Zoom and recordings will be posted 1 day after class.

Lectures:

Thursday 9:00-11:00

Tutorials/Office hours

Thursday 11:00-12:00 after class

Course Grade:

Short Quizzes (7) 35 %

Assignments (4) 40 %.

Video presentation 25% (20% for video, 5% for participation in discussion)

E-MAIL ENQUIRIES: E-mail is not an effective means for teaching or discussion of scholarly material. Students are encouraged to attend office hours (or make an appointment to meet outside of office hours) and discuss topics in person with the instructor. I will only answer **short emails** through the Quercus messaging system, and anything that requires a detailed answer I'll ask you come to the course office hours, after class. I will try and use the Quercus message board for any questions that I feel multiple students pose.

TENTATIVE COURSE OUTLINE

Week 1 – January 12th Orientation on Physical Oceanography

Physical Oceanography as a Branch of Physics
Environmental Challenges in Oceanography
Introduction to Marine Systems (Physical)
The World Ocean
Ocean Morphology
Sea Water: Physical & Chemical Properties

Week 2 – January 19th FORCES ON THE GLOBAL OCEAN 1: Thermo-Haline Circulation

Deep ocean overturning thermohaline circulation

Quiz #1 : on Friday Jan 20th

ASSIGNMENT 1 issued

Basic properties of ocean temperature and salinity. Due week 4.

Computer lab tutorial on Java Ocean Atlas

(Java Ocean atlas will be used for T/S diagrams in assignment 4 as well).

Week 3 – January 26th FORCES ON THE GLOBAL OCEAN 2: WIND

Surface Currents & Ekman Circulation
Inertial Currents and Geostrophic Currents
Oceanic Fronts
Gyres, Rings, Eddies
Atlantic Ocean
North Atlantic Gyre

Week 4 – February 2nd FORCES ON THE GLOBAL OCEAN 3: WAVES

Wind Waves in Ocean Current Systems
Wave Generation & Propagation: Wind Waves & Swell
Wave Breaking & Decay, Wave Boundary Layers
Storm surges
Tsunamis

ASSIGNMENT 2 issued: Waves due in week 6.

Quiz #2 on Friday Feb 3rd

Week 5 – February 9th FORCES ON THE GLOBAL OCEAN 4: OCEANIC TIDES

Equilibrium Theory of Tides
Tidal Constituents & Dynamical Theory of Tides
Amphidromic Systems, Tidal Currents

Quiz #3 on Friday Feb 10th

Week 6 February 16th OCEAN

MARINE-FRESHWATER INTERFACE: ESTUARIES

Morphology & Estuary Types

Estuarine Processes

Environmental Problems

Quiz #4 on Friday Feb 17th

ASSIGNMENT 3 issued: Tides – due in week 8

Reading Week Tuesday February 21 - Friday, February 24

Week 7 – March 2nd Arctic and Antarctic

Importance of sea ice

Upper & Intermediate Water Masses Deep and Bottom Water Masses

T/S diagrams

Quiz #5 on lecture 7 Friday March 3rd

Week 8 – March 9th Pacific Ocean

El Nino Southern Oscillation (ENSO)

Indian Ocean

Tropical Monsoon

The Equatorial Current Systems

The Subtropical Gyres

The Equatorial Undercurrent

ASSIGNMENT 4 issued: Temperature-salt diagrams – due week 10

Week 9 – March 16th

Presentation on how to make good presentations for final video presentations.

Quiz #6 on lecture 8, Friday March 18th

Week 10 March 23rd

DISTRIBUTION OF BIOLOGY

Phytoplankton and Zooplankton, Red Tides

Oxygen and Nutrient distributions

Upwellings zones, CO₂ uptake in ocean

Week 11 March 30th

Global climate change – role of ocean,

Quiz #7 (on lectures 10 and 11) , Friday March 31st

Week 12 April 6th.

Finish course by watching a sample of 10-minute student video presentations on Ocean Currents.

TEXTBOOK

Two texts from the UK Open University that will be used in this course as the textbook. You can buy them from Amazon (there are many 2nd hand copies) but these two books are available online through the U of Toronto library website

Ocean circulation –

<http://simplelink.library.utoronto.ca/url.cfm/51807>

Waves, tides, and shallow-water processes -

<http://simplelink.library.utoronto.ca/url.cfm/51808>

Other useful texts are "Regional Oceanography: an Introduction" by Matthias Tomczak and Stuart Godfrey. A PDF version of this book is available at

<http://gyre.umeoce.maine.edu/physicalocean/Tomczak/regoc/pdfversion.html>

A more technical book is "Introduction to Physical Oceanography" by Robert Stewart.

A PDF version of this book is available at

http://oceanworld.tamu.edu/resources/ocng_textbook/PDF_files/book_pdf_files.html

and the online version is available at

http://oceanworld.tamu.edu/resources/ocng_textbook/contents.html

We are also able to access the online "Encyclopedia of Ocean Sciences". The encyclopedia was published in 2001 and is the most up-to-date resource on oceanography available. Here is a link to the encyclopedia

<http://simplelink.library.utoronto.ca/url.cfm/282540>

PLAGIARISM

University of Toronto Scarborough code of Behaviour on Academic Matters states that "it shall be an offense for a student knowingly: to represent as one's own any idea or expression of an idea or work of another in any academic examination or term test or in connection with any other form of academic work, i.e., to commit plagiarism."

Any form of plagiarism will not be tolerated. Students suspected of plagiarism will be reported based on University policy and code of behaviour (please refer to the University Calendar for more details).

<https://utsc.calendar.utoronto.ca/4-academic-integrity>

<https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019>