OCES 4001 Ocean and Climate Change
(3 Credits)

Course Description:
Ocean is the largest carbon reservoir on the Earth. It plays a central role in regulating the global climate but is currently under severe anthropogenic stress. This course provides students with relevant scientific background in ocean and climate, which enables them to understand the past, present and future climate changes. The impacts of human-induced changes of ocean and climate will also be investigated.

Learning Objectives:

- Demonstrate a solid understanding of physical processes that shape climate.
- Evaluate evidence for past and future climate change.
- Explain the consequences, risks, and uncertainties of climate change.
- Explain the principles behind oceanic and atmospheric variabilities to climate change.

Pre-requisites:

OCES 2001 AND OCES 2003

Assessment

Midterm take-home exam Final	45%
take-home exam Class	45%
participation	10%

Examination

Both exams contain essay-type questions. The midterm is marked out of 50, with 35 marks allocated for short/numerical questions, 10 marks for a short essay question, and 5 marks for general presentation and referencing. The final exam is marked out of 50, distributed unevenly into five short essay-type questions. Limitations on the lengths of answers are imposed. Irrelevant information or extra writing shall result in lower marks.

Make up exam:

If you have time clash, a written petition must be submitted at least 2 weeks before the exam, or else NO make-up exam will be arranged. Should you fall ill on the exam date, you MUST present a doctor's certificate/note/excuse slip. Proof of consultation is NOT acceptable. The course instructors reserve rights to make special exemptions.

List of References:

1. "Mathematics and Climate", H. Kaper & H. Engler, 2013
2. "Introduction to Modern Climate Change", A. Dessler, CUP, 2016
3. "Climate Change: Past Present and Future", M. -A. Melieres & C. Marechal, Wiley, 2015
4. "Global Physical Climatology", D, Hartmann, 2015 (2nd edn.)
5. IPCC assessment reports (AR4, AR5, and the drafts of AR6)

Teaching and Learning Activities

Each lecture follows the following split: 60 minutes of material and concepts, plus 20 minutes of utilizing the material/concepts to discuss climate impacts. Class participation is highly encouraged via Zoom. Optional quizzes will be released for practice purposes.

Email Communication:

We follow a 48 hour email return policy i.e., please allow at least 48 hours before your email is addressed. Implication: Emails sent to the instructors the day before assignment deadline, midterms or final exams will not be addressed in time before the due date.

Academic Integrity

Collaboration is encouraged and valued in this class. However, you have to complete your own work independently. Suspected cheating in assignments will automatically receive a zero and reported to the department. Any other suspected case of cheating, plagiarism, or academic misconduct will be handled according to University policy. Please refer to the webpage: http://acadreg.ust.hk/generalreg.htmlLinks to an external site. as a refresher of appropriate your academic conduct.

Disability Accommodation

To request academic accommodations due to a disability, please contact Advisor to Students with Special Needs.

OCES 4001 Ocean and Climate Change

Week	Topic
1	Intro to climate (weather vs climate, why study climate)
2	Intro to climate (statistical concepts)
	Energy balance model (intro and 0d model)
3	Energy balance model (albedo, greenhouse gases, multiple equilibria, Milankovitch cycles, and beyond 0d model)
	The atmosphere (structure, composition, phenomena)
4	The atmosphere (winds, Coriolis force, geostrophic flow)
	Troposphere (meridional circulation)
5	Troposphere (longitudinal circulation, modes of variability)
	Stratosphere (features and ozone)
6	Stratosphere (Brewer-Dobson circulation, QBO, polar vortex)
	Past climates (intro, revisit Milankovitch cycles, proxies)
7	Review of atmosphere session and the IPCC
	Mid-term Exam
8	The ocean as a key component of the climate system
	Ekman transport and wind-driven circulation
9	***Holiday***
	Water masses and overturning circulation
10	Baroclinicity, mesoscale eddies, and diapycnal mixing
	Pacific Ocean (circulations, ENSO, PDO, NPGO)
11	Atlantic Ocean (circulations, AMM, NAO, EAP, AMO)
	Indian Ocean (circulations, monsoon, IOD)
12	Southern Ocean (circulations, fronts, SAM, ice shelves)
	Arctic Ocean and Nordic Seas (circulations, NAM, ice drift)
13	Interocean and inter-basin exchanges
	Sea-level, heat content, and salinity changes
14	Review of ocean session
	Final Exam