The Hong Kong University of Science and Technology

UG Course Syllabus

Coral Reef Ecosystem Science

OCES 4204

No. of Credits: 4

Pre-/co-requisites: OCES 3003 AND OCES 3160

Name:

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Teaching Assistants (TAs)

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Course Description

This course provides a grounding in the theory required for comprehensive multi-disciplinary study of subtidal coastal ecosystems. Using coral reefs as an example, lectures will explore global values and threats on coral reefs, the physical, biogeochemical and ecological factors controlling their structure and function, and how to study these factors using integrative, multidisciplinary research based on the concepts of ecosystem science.

Intended Learning Outcomes (ILOs)

On successful completion of this course, students are expected to be able to:

1. explain complex interactions between oceanography and the ecology of coastal ecosystems,
2. explain the structure and function of coral reef ecosystems and their basic drivers,
3. formulate scientific hypotheses and design appropriate tests based on theoretical concepts and contemporary literature in the form of a robust scientific or consulting proposal,
4. work collaboratively in a multi-disciplinary group to plan a (remote) field research project, maximising both safety and scientific return per unit effort and expense, including through the preparation of risk assessments,
5. demonstrate familiarity with a wide range of sampling techniques used to survey subtidal coastal ecosystems,
6. demonstrate familiarity with a range of oceanographic instrumentation used in coastal research,
7. critically evaluate and explain sustainability issues relating to coral reef ecosystems, and
8. demonstrate a global perspective on coral reef ecosystems and links to cultures that depend
9. on them.

Expected Preparation

A basic background in biological and physical oceanography is expected to be obtained from required OST courses (e.g., OCES 2001, 2002, and 2003). Students must have completed OCES 3003 (Field Methods in Marine Studies) and OCES 3160 (Ecology). Enrolment by research postgraduate students will be possible subject to approval. Students will be required to conduct independent reading before the commencement of the course and prior to each week's lectures.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Class participation	10%	N/A
Journal Club	15%	Refer to the schedule
Case Study	30%	Refer to the schedule
Research Proposal	20%	Refer to the schedule
Group project & presentation	25%	6-8/05/2025

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Class participation	ILO1, ILO2, ILO4, ILO5, ILO6, ILO7, ILO8	Participation will be assessed both informally (e.g., questions during class) and formally (e.g., online quizzes to be completed prior to classes on Canvas, student sharing in class, participation in lab or field experience sessions).
Journal Club	ILO1, ILO2, ILO3, ILO7, ILO8	Regularly throughout the semester, each student (once each) will be assigned a paper focusing on coral

		ecosystem science (from a provided list) to read thoroughly and present to the class, explaining the background and rationale (with reference to other literature as needed), outlining the major technique(s) used, and the major conclusions of the study in the context of ecosystem science. All students will be expected to at least skim-read the assigned papers prior to the respective classes and actively participate in the discussions. The presenting student will lead each discussion, including posing questions to the class based on the paper and course content.
Case Study	ILO2, ILO3, ILO5, ILO7, ILO8	Pick a scientific question related to coral reef ecosystem science and perform a thorough literature review on it, then draft a coral reef "Case Study" chapter that could be included in the textbook based on your reading (see case study chapters in Section V of WEA). Topics should focus on interdisciplinary interactions between at least two of (1) biological, (2) chemical and (3) physical process on coral reefs. Extra marks will be given for original data synthesis or analysis.
Research Proposal	ILO1, ILO2, ILO3, ILO4, ILO6, ILO7	You will propose a modern update to a classic paper in coral ecosystem science (to be provided). This paper offered considerable insights into the ecosystem function of coral reefs but, being conducted in the mid-20th century, did not have access to the methodology and equipment available today. Your task will be to identify gaps, uncertainties or follow-on questions that could be addressed with more modern approaches. The proposal for an updated follow-up study, at a field location of your choosing, will follow a standard research proposal format of Background, Aims, Methodology, Equipment Needs, Statement of Impact, and References. This will be a blue-skies proposal with no budget limit or consideration to cost. The proposal will be assessed on the basis that it identifies a well-justified approach, based on contemporary methods and equipment, and seems likely to provide exciting new insights based on the methodology/location proposed.
Group project & presentation	ILO1, ILO3, ILO4, ILO5, ILO6, ILO7, ILO8	As part of an assigned group students will form a consultancy and, reporting to the Teaching Assistants (TAs) acting as the Client, prepare a proposal/quotation to address an interdisciplinary problem associated with Hong Kong's coral reef ecosystems. The specifications will be presented to you as a 'Request for Proposal' or 'Request for Tender' from the client. Tenders will be assessed based on justification (background information), clear objectives/hypotheses, a feasible approach that addresses the specifications, and realistic budget within defined limits. Each group will present their research proposal to the client and class as an oral presentation and receive feedback from their peers, the client (TAs), and the instructor. This assignment will provide experience in the realities of preparing proposals or tenders that students will encounter working in

		academia or industry (e.g., consulting), as well as conducting science-based presentations aimed at securing funding or contracts (i.e., “sales pitches”).

Grading Rubrics

Detailed rubrics for each assignment will be provided. These rubrics clearly outline the criteria used for evaluation. Students can refer to these rubrics to understand how their work will be assessed.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of subject matter, expertise in problem-solving, and significant creativity in thinking. Exhibits a high capacity for scholarship and collaboration, going beyond core requirements to achieve learning goals.
B	Good Performance	Shows good knowledge and understanding of the main subject matter, competence in problem-solving, and the ability to analyze and evaluate issues. Displays high motivation to learn and the ability to work effectively with others.
C	Satisfactory Performance	Possesses adequate knowledge of core subject matter, competence in dealing with familiar problems, and some capacity for analysis and critical thinking. Shows persistence and effort to achieve broadly defined learning goals.
D	Marginal Pass	Has threshold knowledge of core subject matter, potential to achieve key professional skills, and the ability to make basic judgments. Benefits from the course and has the potential to develop in the discipline.
F	Fail	Demonstrates insufficient understanding of the subject matter and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

Students may use generative AI tools to support their learning, but **all AI-generated material must be clearly acknowledged and cited**, including the original source material where relevant. Students are responsible for verifying the accuracy of any AI output; generative AI tools are known to omit citations, fabricate references, and provide superficially plausible but incorrect information, particularly on technical topics.

Failure to acknowledge AI use constitutes plagiarism under HKUST’s Academic Integrity policy. The minimum penalty is a zero for the assessment and misconduct proceedings may jeopardize academic standing and future studies.

Required Texts and Materials

Primary reference textbook(s):

• Weathers, K.C., Strayer, D.L. and Likens, G.E. (2021) Fundamentals of ecosystem science.

Second Edition. Academic Press, Waltham, Massachusetts, USA. 358 p. [WEA]

- Library access: https://lbdiscover.ust.hk/bib/991013024045303412

• Sheppard, C., Davy, S.K., Pilling, G.M. and Graham, N.A.J. (2018) The Biology of Coral Reefs.

Second Edition. Oxford University Press, Oxford, United Kingdom, 370 p. [SHE]

- Library access: https://lbdiscover.hkust.edu.hk/bib/991012401099703412 (first edition)

Supplementary materials

• A range of reading and web resources will be made available on Canvas (canvas.ust.hk)

prior to each lecture as handouts [HO].

Additional textbook(s):

Besides the primary reference textbook, required reading takes the form of peer-reviewed journal articles, which are made available through Canvas. We specifically avoid heavy reliance on these coral reef textbooks since the applied information is often quickly outdated. However, several books that may serve as useful resources to supplement core foundational knowledge for the subject include:

• Bertness, M.D., Bruno, J.F., Silliman, B.R. and Stachowicz, J.J. (2014) Marine community ecology and conservation. Sinauer Associates, 560 p. [BER]

- Library access: https://lbdiscover.ust.hk/bib/991013015207003412

• Kayanne, H. (2016) Coral reef science: strategy for ecosystem symbiosis and coexistence with humans under multiple stresses. Springer Japan, Tokyo, 101 p. [KAY]

- Library access: https://lbdiscover.ust.hk/bib/991012683050103412

• Nybakken, J.W. and Bertness, M.D. (2004) Marine biology: an ecological approach. Sixth Edition. Benjamin Cummings, San Francisco, 579 p. [NYB]

- Library access: https://lbdiscover.ust.hk/bib/991013015402803412

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Learning Activities

This is not a typical lecture course where students sit and listen to a series of lectures and then repeat concepts in a final exam – a high degree of interaction and participation in the learning experience will be required to get the most from the course. Part of the course content will necessitate independent study to be completed prior to class sessions; students will be called upon to share their thoughts with the class,

including but not limited to during Journal Club, so prior preparation will be essential (time is provided in the schedule to ensure this is possible). In addition to the defined assessment tasks (which are focused on providing relevant experience beyond pure written assessments), opportunities will be offered to participate in a field trip(s) focused on Hong Kong's coral reef ecosystems as logistical constraints allow. Further details will be provided in class.

Course schedule

Wk	Date	Topic	Key Text
1	4 Feb	Course preparation, independent reading, video discussion **[No class]**	-
	6 Feb	Course introduction – what is a coral reef?	HO
2	11 Feb	Introduction to ecosystem science	WEA Ch.1 + HO
	13 Feb	Coral reefs: biodiverse and productive tropical ecosystems	SHE Ch 1
3	18 Feb	Ecosystem science approaches – not just biology! *[Journal Club selection] + [Instrument familiarisation]*	WEA Ch.1 + HO
	20 Feb	Introduction to ecological energetics	WEA Sec.II
4	25 Feb	Coral ecosystem primary producers and production rates	WEA Ch.2 + SHE Ch.2
	27 Feb	Group Project meeting **[No class]**	-
5	4 Mar	Introduction to coral reef environments and hydrodynamics	SHE Ch.3 + HO
	6 Mar	**Journal Club 1:** Connecting coastal oceanography and coral ecosystems across scales	HO
6	11 Mar	Coral feeding, symbioses and dysbiosis, and calcification	Ch.4 + HO
	13 Mar	**Journal Club 2:** Drivers of niches and production, and their measurement	SHE Ch.3.8 + HO
7	18 Mar	Coral ecosystem biogeochemistry: nutrient cycling & organic matter dynamics	WEA Ch. 6
	20 Mar	**Journal Club 3:** Coral ecosystem biogeochemistry	HO
8	25 Mar	Coral ecosystem secondary producers and consumer energetics	WEA Ch.3 + SHE Ch.6
	27 Mar	**Journal Club 4:** Drivers of coral fishes and secondary production	HO
9	**1 Apr**	**MID-TERM BREAK [No class]**	-
	3 Apr	**MID-TERM BREAK [No class]**	-
10	8 Apr	Group Project meeting **[No class]**	-
	10 Apr	Independent reading preparation / Group Project meeting **[No class]**	-
11	15 Apr	Guest Lecture	HO
	17 Apr	Climate change and coral bleaching, Human interactions with reefs: resources and impacts	HO
12	22 Apr	**Journal Club 5:** Human impacts, management and conservation	HO
	24 Apr	Ethical considerations in coral ecosystem research: parachute science and decolonization	HO
13	29 Apr	New frontiers in ecosystem science: mesophotic coral ecosystems	WEA Ch. 19 + HO
	1 May	**HOLIDAY [No class]**	-
14	6 May	**Group Project Presentations**	-
	8 May	Course review **Group Project Presentations**	-