The Hong Kong University of Science and Technology

UG Course Syllabus

Course Title: Climate Modeling and Risk Assessment

Course Code: CIVL4480/ ENVR4480

No. of Credits: 3

pre-/co-requisites: MATH 1003 or MATH 1012 or MATH 1013 or MATH 1014 or MATH 1020 or MATH 1023 or MATH 1024

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Course Description

The primary aim of this course is to convey fundamental scientific knowledge of the Earth's climate system, to develop technical skills for climate modeling and data analysis, and to understand the relationship between the impacts of climate change and strategies to manage the associated risks. Emphasis will be placed on the "practical exercise" for simulating future climates in response to different levels of anthropogenic greenhouse gases using the web-based global climate model (EdGCM), which features a user-friendly interface that can be run on a laptop or desktop computer. Through this practice, students will learn the complete scientific processes related to climate modeling, such as experimental design, running simulations, data analysis, and interpretation of results. Based on this foundation, the latter half of the course will shift to topics related to the identification and assessment of the risks from climate extremes. Ultimately, students will gain familiarity with climate modeling techniques and a better understanding of how to grapple with a myriad of complex climate issues.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

ILO-1: Demonstrate a solid understanding of the Earth's climate system

ILO-2: Describe the structure of climate models and how to assess their performance and uncertainty

ILO-3: Acquire the technical skills to handle general procedures related to climate modeling and analyze their output

ILO-4: Describe the key concepts of climate risks and explore approaches for mitigating these risks in a changing climate

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
Report 1 (Climate Modeling)	25%	17/03/2025
Mid-Term examination	25%	26/03/2025
Report 2 (Risk Assessment)	20%	30/04/2025
Final examination	25%	To be determined
Attendance	5%	All weeks

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Report 1 (Climate Modeling)	ILO-2, ILO-3	This task evaluates students' ability to conduct climate modeling, covering experimental design, post-processing of model outputs, and interpretation of results with graphic software.
Report 2 (Risk Assessment)	ILO-3, ILO-4	This task assesses students' ability to analyze the climate-related risks using their simulations, demonstrating technical skill in data analysis and critical thinking in assessing the impacts of meteorological variables on energy sectors.
Mid-term and final examination	ILO-1, ILO-2, ILO-3, ILO-4	This task assesses students' ability to comprehensively understand course materials that include the theoretical foundations of climate modeling and the concept of anthropogenic climate change and to integrate the knowledge acquired while completing two report assignments.

Grading Rubrics

Report 1 (Climate Modeling)

Criteria	Excellent	Good	Satisfactory	Marginal	Fail
Modeling and data analysis	Well organized experimental design, the completion of multiple long-term simulations and analysis of multiple meteorological variables	Organized experimental design, the completion of a few long-term simulations, and analysis of a few meteorological variables	Limited experimental design with a few simulations and analysis of a few meteorological variables	Limited experimental design with a single simulation and analysis of a single meteorological variable	No simulations conducted

Report structure and overall quality	Clear and well organized presentation with multiple accurate graphs and reasonable explanations	Well-organized presentation with several accurate graphs and some explanations	Organized presentation with a few graphs and basic explanations	Presentation with limited organization, a single graph, and unclear explanations	Poorly organized presentation with no graphs and inadequate explanations.

Report 2 (Risk Assessment)

Criteria	Excellent	Good	Satisfactory	Marginal	Fail
Climate model output processing and solar power potential calculation	Accurate processing of relevant meteorological variables to calculate solar power potential and compare the results derived from various empirical formulas	Adequate processing of relevant meteorological variables to calculate solar power potential and compare the results derived from a few empirical formulas	Limited accuracy of meteorological variables, but an attempt to calculate solar power potential using several empirical formulas	Limited accuracy of meteorological variables and the calculation of solar power potential with no comparative assessment	Inaccurate calculation of solar power potential with a wrong simulation output
Report structure and overall quality	Clear and well organized presentation with multiple accurate graphs and reasonable explanations	Well-organized presentation with several accurate graphs and some explanations	Organized presentation with a few graphs and basic explanations	Presentation with limited organization, a single graph, and unclear explanations	Poorly organized presentation with no graphs and inadequate explanations.

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 meticulous data handling, 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.
C	Satisfactory Performance	Possesses adequate knowledge of core subject matter, competence in dealing with familiar problems, and some capacity for analysis and critical thinking.
D	Marginal Pass	Has threshold knowledge of core subject matter, potential to achieve key professional skills, and the ability to make basic judgments.
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.

Course AI Policy

The use of Generative AI in project is permitted with proper acknowledgement and will NOT be contributed to the students' work.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include specific details (e.g., strengths, areas for improvement). Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Required Texts and Materials

Kendal McGuffie and Ann Henderson-Sellers (2005). A Climate Modelling Primer, 3rd edition. John Wiley & Sons Ltd. [Available in the library]

F. W. Taylor (2005). Elementary Climate Physics, 1st edition. Oxford University Press [Available in the library]

C. Donald Ahrens & Robert Henson (2016) An introduction to weather, climate and the Environment [Available in the library]

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.