SEE4212: PHYSICS OF CLIMATE

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Physics of Climate

Subject Code
SEE - School of Energy and Environment
Course Number
4212

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
SEE3201 Atmospheric Science – An Introductory Survey

Precursors
Nil

Equivalent Courses
AP4258 Atmospheric Circulation Systems and Climate

Exclusive Courses
Nil

Part II Course Details

Abstract
The course is designed for the undergraduate students in the Atmospheric and Climate Science minor program. Students will be enabled to discover the general circulation of the atmosphere and ocean, and knowledge in the basic physics governing

the earth’s climate system will be provided. Emphasis is put on the large-scale dynamics of the atmosphere and the ocean, and the interaction between them.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the key components of the climate system	10		x	
2	Describe the global energy balance and hydrological cycle	20		x	
3	Discover, describe and explain the general circulation of the atmosphere	30		x	
4	Discover, describe and explain the general circulation of the ocean	30		x	
5	Discover, describe and explain some climate variability and climate change phenomena	10		x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students will attend lectures which explain key concepts, such as theories related to physics of climate.	1, 2, 3, 4	2.15
2	Tutorials	Students will attend tutorials which solidify students’ concepts with practice.	1, 2, 3, 4, 5	0.55
3	Group Discussion	Students will share different opinions or solutions on climate system in group discussion.	2, 3, 4, 5	0.30

Additional Information for LTAs

Suggested lecture/tutorial/laboratory mix: 2 hrs lecture + 1 hr tutorial, with the tutorial following the completion of one complete topic within a specific CILO

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Class Work: Students will participate in in-class assessment tasks to apply theories and concepts in climate physics.	1, 2, 3, 4, 5	10	-	Yes
2	Assignments: Students will apply knowledge and concepts in climate physics to complete assignment questions.	1, 2, 3, 4	10	-	Yes
3	Midterm Quiz: There will be a midterm quiz for the instructor to assess students' learning progress on the theories and concepts in climate physics.	1, 2, 3	20	-	No

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

Students will take the final exam to demonstrate their ability to apply knowledge and concepts in climate physics. Examination duration: 2 hrs Percentage of continuous assessment, examination, etc.: 40% by continuous assessment; 60% by exam To pass a course, a student must do ALL of the following: 1) obtain at least 30% of the total marks allocated towards continuous assessment (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable); 2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and 3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

1. Class Work

Criterion
Ability to analyse questions related to atmospheric circulation and climate variation

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
2. Assignment

Criterion
Ability to evaluate and analyse questions related to physics of climate

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
3. Midterm Quiz

Criterion
Ability to analyse questions related to physics of climate

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)

Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
4. Examination

Criterion
Ability to analyse questions related to physics of climate

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- Introduction to climate system
  Atmospheric temperature and composition, the world ocean, the cryosphere, land surface
- Global energy balance and hydrological cycle
  Radiative transfer, solar and terrestrial radiation, radiation flux balance, poleward energy flux, water balance, surface storage and runoff, evapouration, precipitation and transpiration
- Hydrostatics of the atmosphere
  Hydrostatic equation, thermodynamic structure of the atmosphere, atmospheric stability.
- Basic atmospheric dynamics
  Dynamics of horizontal flow, geostrophic wind, gradient wind, thermal wind, pressure as vertical coordinate, primitive equations.
- Atmospheric general circulation
  Energy balance of the atmosphere, atmospheric motion and energy transport, large-scale circulation patterns
- Oceanic general circulation
  Properties of sea water, the mixed layer, wind-driven circulation, thermohaline circulation, transport of energy in the ocean, atmosphere-ocean coupled processes
- Climate variability
  Natural climate change, anthropogenic climate change

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	An Introduction to Dynamic Meteorology, J.R. Holton, G. J. Hakim (Academic Press, 5th edition, 2012).
2	Physics of Climate, J. P. Peixoto and A. H. Oort (American Institute of Physics, 1992)
3	Global Physical Climatology, D. L. Hartmann (Academic Press, 1994)
4	The Oceans and Climate, G.R. Bigg (2nd ed. Cambridge University Press, 2004)