

SEE4212: PHYSICS OF CLIMATE

Effective Term

Semester A 2022/23

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.

Teaching and Learning Activities (TLAs)

TLAs	Brief Description	CILO No.	Hours/week (if applicable)	
1	Lectures	Explain key concepts, such as theories related to physics of climate	1, 2, 3, 4	2.15
2	Tutorials	Solidify students' concepts with practice	1, 2, 3, 4, 5	0.55
3	Group Discussion	Share different opinions or solutions on climate system	2, 3, 4, 5	0.30

Additional Information for TLAs

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 (e.g. Parameter for GenAI use)
1	Class Work	1, 2, 3, 4, 5	10	
2	Assignment	1, 2, 3, 4	10	
3	Midterm Quiz	1, 2, 3	20	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

Examination duration: 2 hrs

Percentage of coursework, examination, etc.: 40% by coursework; 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 coursework (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, evaporation, 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 (Academic Press, 4th edition, 2004).
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 (Cambridge University Press, 1996)