

25UMCET402	CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT	Category	L	T	P	R	Credit	Year of Introduction
		VAC	4	0	0	0	4	2025

Preamble: This course introduces the fundamentals of climate change, its drivers and impacts, and the principles of sustainable development. It emphasizes mitigation, adaptation strategies, and policy frameworks to enable climate-resilient and sustainable engineering practices.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Explain basic climate concepts, atmospheric structure, circulation, and meteorological processes.	K2 Understand
CO2	Describe climate change drivers, greenhouse effect, evidence of global warming, and key environmental impacts.	K2 Understand
CO3	Explain sustainable development principles, mitigation and adaptation strategies, and carbon management concepts.	K2 Understand
CO4	Describe international and national climate policy frameworks and case studies on climate change mitigation and adaptation	K2 Understand

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	–	–	–	1	–	–	–	–	–
CO2	1	2	–	–	–	3	1	–	–	–	–
CO3	1	–	2	–	–	3	–	–	–	–	1
CO4	–	1	–	–	–	2	1	–	–	–	2
Avg	1.33	1.67	2	-	-	2.25	1	-	-	-	1.5

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*		*		
CO2	*	*	*	*	*		*		*
CO3	*	*	*	*	*		*	*	
CO4	*	*	*	*	*		*	*	*

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*		*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
 Continuous Assessment Test : 20 marks
 Continuous Assessment Assignment/Activity : 15 marks

SYLLABUS

Module 1 (14 hrs)

Introduction to climate and weather – distinction between weather and climate; Earth's energy balance; solar and terrestrial radiation; albedo and emissivity. Atmospheric structure and composition – layers of the atmosphere; composition; variation of pressure, density, and temperature with altitude. Scales of atmospheric motion – large-scale circulation patterns; general circulation of the atmosphere; troposphere–stratosphere transport. Fundamentals of meteorology and climate dynamics – basic atmospheric thermodynamics; radiative processes; introduction to photochemical processes. Atmospheric photochemistry and chemical kinetics – role of chemical reactions and photochemical processes influencing climate.

Module 2 (14 hrs)

Natural and anthropogenic drivers of climate change – solar variability, volcanic activity, and human-induced greenhouse gas emissions. Greenhouse gases and greenhouse effect – major greenhouse gases, their sources, and the mechanism of global warming. Evidence and indicators of global warming – observed temperature trends, melting of glaciers and polar ice, sea-level rise, and overview of climate models. Impacts on the biosphere and hydrosphere – effects on the hydrological cycle, agriculture, forests, ecosystems, and biodiversity. Urbanization and climate interactions – urban sprawl, urban heat island effect, climate-induced flooding, and impacts on local and regional climate.

Module 3 (14 hrs)

Principles of sustainable development – sustainability indicators; life cycle assessment (LCA); material flow analysis (MFA). Sustainable urban planning and green infrastructure – energy-efficient buildings; green energy systems; waste management and 3R principles. Climate change mitigation – renewable energy technologies; energy efficiency; greenhouse gas emission reduction strategies. Green engineering and circular economy – sustainable design; waste minimization; resource efficiency and recycling. Climate change adaptation – resilient infrastructure; nature-based solutions; disaster risk reduction. Carbon sequestration and vulnerability – carbon cycle; carbon capture and storage (CCS); bioenergy crops; climate vulnerability assessment.

Module 4 (14 hrs)

International climate frameworks and agreements – overview of the Kyoto Protocol, Paris Agreement, and Montreal Protocol. Policy instruments and multilateral initiatives – role, structure, and functions of IPCC, UNFCCC, and other international climate institutions. National and regional sustainability policies – climate policy frameworks; National Action Plan on Climate Change (NAPCC); alignment with Sustainable Development Goals (SDGs). Case studies and emerging strategies – international best practices in climate mitigation and adaptation; sustainable development initiatives; emerging challenges and future pathways for climate-resilient development.

Recommended Activity

Estimate the carbon footprint of a household / campus using standard carbon calculators. Identify major emission sources and evaluate feasible mitigation and adaptation measures.

Text Books:

1. Maslin, M. (2014). *Climate change: A very short introduction* (1st ed.). Oxford University Press.
2. Sharma, S., & Sharma, K. (2023). *Environment and society: Climate change and sustainable development* (1st ed.). Routledge India (Taylor & Francis Group).
3. Fulekar, M. H., & Dubey, R. S. (2015). *Climate change and sustainable development*. Taylor & Francis.
4. Streimikiene, D., & Mikalauskiene, A. (2021). *Climate change and sustainable development: Mitigation and adaptation* (1st ed.). CRC Press (Taylor & Francis Group).

Reference Books:

1. Sinha, A., & Misra, S. (2001). *Economic development, climate change and the environment* (1st ed.). Routledge India.
2. Van Dam, J. C. (2003). *Impacts of climate change and climate variability on hydrological regimes*. Cambridge University Press.
3. Lal, D. S. (n.d.). *Climatology*. Sharda Pustak Bhawan. ISBN 8186204121.
4. Hardy, J. T., & Ponce, J. (2003). *Climate change: Causes, effects, and solutions*. Wiley.
5. Keengwe, J., & Nyatuka, B. O. (2023). *Climate change education for sustainable development* (1st ed.). IGI Global.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	25UMCET402
Course Name	CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT
Max. Marks: 60	Duration: 2.5 Hours

Part A <i>(Answer all questions. Each question carries 3 marks)</i>				
Qn No.	Question	Marks	CO	BL
1	Distinguish between weather and climate.	3	1	L2
2	Describe the composition of the atmosphere.	3	1	L2
3	Explain the relationship between urbanization and climate change.	3	2	L2
4	Summarize the major greenhouse gases and their sources.	3	2	L2
5	Describe sustainable development and sustainability indicators.	3	3	L2
6	Summarize any three renewable energy technologies.	3	3	L2
7	Outline the objectives of the Kyoto Protocol.	3	4	L2
8	Explain the role of the IPCC in climate policy.	3	4	L2
Part B <i>(Answer any one full question from each Module. Each carry 9 marks)</i>				
Module I				
Qn No.	Question	Marks	CO	BL
9	Describe the structure of the atmosphere and explain the variation of temperature with altitude.	9	1	L2
OR				
10	Explain the significance of photochemical processes and chemical kinetics in climate dynamics.	9	1	L2
Module II				
Qn No.	Question	Marks	CO	BL
11	Explain the greenhouse effect and the role of greenhouse gases in global warming.	9	2	L2
OR				
12	Describe the causes and consequences of urban heat islands and climate-induced flooding.	9	2	L2
Module III				
Qn No.	Question	Marks	CO	BL
13. a	Explain the applications of Life Cycle Assessment (LCA) and Material Flow Analysis (MFA).	5	3	L2

13. b	Describe the 3R principles in waste management.	4	3	L2
OR				
14. a	Explain the principles of green engineering and circular economy.	5	3	L2
14. b	Describe carbon sequestration.	4	3	L2
Module IV				
Qn No.	Question	Marks	CO	BL
15	Explain the role of the IPCC in climate policy.	9	4	L2
OR				
16	Explain the National Action Plan on Climate Change (NAPCC) and its missions.	9	4	L2
