



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE05013071

Subject Name: Global Warming and Climate Change

w. e. f. Academic Year:	2025-26
Semester:	5
Category of the Course:	Professional Elective - II

Prerequisite:	Basic understanding of Environmental Science. Familiarity with fundamental atmospheric and environmental processes is desirable.
Rationale:	Global warming and climate change are critical environmental challenges driven by increasing greenhouse gas emissions. This course takes students through a journey from understanding the causes and impacts of climate change to exploring mitigation technologies and policy frameworks. It equips students to address climate issues with integrated technical and policy-based solutions.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Explain greenhouse gas emissions and inventory, mechanisms of global warming, and their effects on Earth's energy balance and carbon cycle.	22
CO-2	Classify natural and anthropogenic causes of climate change and explain their impacts and mitigation measures.	23
CO-3	Illustrate carbon capture, sequestration, and utilization techniques and compare their effectiveness in emission reduction.	22
CO-4	Describe climate policy frameworks, international agreements, and carbon market mechanisms for climate change mitigation.	23
CO-5	List key components of the climate system, modeling approaches, feedback mechanisms, and major findings of IPCC reports.	10

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL	Total no of hours per semester		Theory		Tutorial / Practical			
						ESE (E)	PA / CA (M)	PA/ CA (I)	PBL (I)	ESE (V)	
45	30	00	15	90	03	70	30	20	30	00	150



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE05013071

Subject Name: Global Warming and Climate Change

Content:

Sr. No.	Content	Total Hrs
1	Greenhouse Gases and Global Warming Significance, types, sources and sinks of greenhouse gases; Greenhouse gas emissions and emission trends; Natural and enhanced greenhouse effect; Introduction to Global warming; mechanisms of global warming; Introduction to the global carbon cycle and its components	10
2	Climate Change: Concepts and Processes Definition and Elements of climate system; Role of each element of climate system; Natural climatic variability and Anthropogenic causes of climate change; Observed trends in climate change; Impacts of climate change at global and regional scales; Introduction to climate change adaptation and mitigation concepts	10
3	Carbon Capture Sequestration and Storage Introduction & Necessity of CCS; Introduction to carbon storage and different sequestration (CCUS): Biological carbon sequestration, Geological carbon sequestration, Technological Carbon Sequestration, Industrial Carbon Sequestration; Carbon capture technologies: post-combustion, precombustion, oxy-combustion; Carbon capture methods: adsorption, absorption, membrane and cryogenic separation processes; CO ₂ Utilization: CO ₂ flooding and methane recovery-Enhanced Coal Bed Methane Recovery	10
4	Climate Policy and Global Frameworks Climate Policy Frameworks: Global and National Perspectives; Key international institutions (UNFCCC, IPCC); Conference of Parties (COP): Structure, functions and major outcomes; Kyoto Protocol and Market-Based Mechanisms: Clean Development Mechanism (CDM), Joint Implementation (JI), Emission Trading (ET); Paris Agreement and Climate Commitments; Carbon Markets: Concepts, types of Carbon Markets; Economic instruments: Carbon Pricing Mechanisms, emission trading mechanisms, Offset Mechanisms	10
5	Climate Change Modeling Understanding the Climate System; Characteristics of climate system components; Basic equation and dynamics of atmosphere; Elementary idea of Global Climate Models; Comparison of various IPCC reports; Important findings of IPCC AR6; Application of AI in Climate Modelling	05
TOTAL		45



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE05013071

Subject Name: Global Warming and Climate Change

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30%	50%	20%	--	--	--

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

The syllabus of *Global Warming and Climate Change* directly contributes to

SDG 7	Affordable and Clean Energy Addresses greenhouse gas reduction, fossil fuel impacts, and transition toward sustainable energy systems
SDG 11	Sustainable Cities and Communities Supports climate resilience, sustainable urban development, and adaptation to climate-related risks
SDG 13	Climate Action Core focus on climate change science, impacts, mitigation, adaptation, and policy

Reference Books:

1. Global Warming by A K Shrivastava
2. Global Warming and Climate Change by Dr Chandravati Shagufta
3. Global Warming by Douglas Long
4. Climate Change: Science, strategies & solutions by Eileen Clausen, Vicki Arryo Cochran
5. Climate change: a multidisciplinary approach by William Kininmouth
6. Climate change: Critical Concepts in the environment by Frank Chambers, Michael Ogle
7. Cites Carbon Capture: Sequestration and Storage (Issues in Environmental Science and Technology), by R E Hester and R M Harrison
8. Carbon Capture and Sequestration Integrating Technology, Monitoring, Regulation by Elizabeth Wilson and David Gerard.
9. Climate Change and the Kyoto Protocol: The Role of Institutions and Instruments to Control Global Change by Michael Faure Joyeeta Gupta Andries and Nentjes

List of Tutorials:

1. Tutorial on greenhouse gas emissions and global warming mechanisms
2. Tutorial on natural and anthropogenic causes of climate change
3. Tutorial on carbon capture technologies and sequestration methods



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE05013071

Subject Name: Global Warming and Climate Change

4. Tutorial on international climate agreements and carbon market mechanisms
5. Tutorial on climate modeling approaches and interpretation of IPCC findings

List of learning website:

1. Climate Change Science, IISc Bangalore, NPTEL Course, https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ce09
2. Fundamental of Carbon Capture, Utilization and Storage, IIT(ISM) Dhanbad, NPTEL Course, https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ch04
3. Basics of Climate Modeling, IIT Hyderabad, NPTEL Course, https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ce08
4. IPCC reports (http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml)

List of suggested activities for Problem-based Learning (PBL):

Sr. No.	PBL Category	Name of the Activity	No. of Hours	Evaluation Criteria
1.	Seminar	Seminar on given technical topics beyond syllabus	Topic Study & Content Preparation = 4 hrs, PPT Preparation = 3 hrs, Seminar Presentation = 2 hrs Total = 10 hrs	Based on technical analysis, data interpretation, report quality and presentation skills
2.	Mini Project	Trend analysis of climate change indicators using meteorological datasets	Data Collection & Analysis = 3 hrs, Report Preparation = 5 hrs, PPT Presentation = 2 hrs Total = 10 hrs	Based on technical analysis, data interpretation, report quality and presentation skills
3.	Case Study Analysis	Compare natural and anthropogenic causes of climate change using regional case studies	Study = 3 hrs, PPT = 2 hr Total = 5 hrs	Based on comparative analysis, presentation quality, and relevance
4.	Video Based Learning	Study greenhouse gases, their sources and global warming impacts through NPTEL/MOOC modules	Learning = 5 hrs	Based on MCQ test
5.	Technical Report Writing	Prepare a technical report on greenhouse gas emissions and global warming case studies (global/India)	Research = 3 hrs, Writing = 2 hr Total = 5 hrs	Based on technical accuracy, data interpretation, and report quality
6.	Group Discussion /	Group discussion or quiz on climate variability,	Discussion/Quiz = 3 hrs, Reflection = 2 hr	Based on participation,



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE05013071

Subject Name: Global Warming and Climate Change

	Quiz	anthropogenic drivers, and regional climate impacts	Total = 5 hrs	technical understanding, and analytical ability
7.	Research Paper Review / Analysis	Review research papers on carbon capture, sequestration, and utilization technologies	Paper Review = 3 hrs, Summary = 2 hr, Total = 5 hrs	Based on technical depth, summary quality, and critical analysis
8.	Industry / Technical Case Study	Analyze CCS/CCUS industrial applications through case studies or industrial reports	Study = 3 hrs, Report = 2 hr Total = 5 hrs	Based on application understanding, technical content, and case interpretation
9.	Poster / Chart / PPT Presentation	Study international climate agreements (Kyoto protocol/Paris agreement) and prepare poster/PPT	Research = 3 hrs, Presentation = 2 hr Total = 5 hrs	Based on clarity, policy understanding, and presentation effectiveness
10.	Assignment / Policy Analysis	Introduction to carbon markets and emission trading	Research = 3 hrs, Report = 2 hr Total = 5 hrs	Based on policy analysis, economic understanding, and report submission
11.	Research Paper Review / Technical Writing	Summarize IPCC findings through report/seminar	Research = 3 hrs, Report = 2 hr Total = 5 hrs	Based on technical interpretation, report quality, and conceptual understanding
