

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NGLD307	<b>Fundamentals of Atmosphere, Ocean, and Climate Dynamics</b>	3	0	0	3

Course Objective
The primary objective of the course is to develop a comprehensive understanding of the fundamental processes governing the atmosphere, oceans, and land systems, while addressing key issues related to climate variability, climate change, and their observed impacts on the Earth system.
Learning Outcomes
Upon successful completion of the course, students will be able to understand: <ul style="list-style-type: none"> <li>The structure, composition, and interactions of the atmosphere, ocean, and land systems.</li> <li>Atmospheric and oceanic processes, including circulation, waves, precipitation, and pollution.</li> <li>Air–sea interactions, climate feedbacks, and coupled atmosphere–ocean systems such as ENSO.</li> <li>Weather and climate systems, particularly the Indian monsoon, cyclones, teleconnections, and precipitation variability.</li> <li>Climate variability, climate change indicators, global warming, sea-level changes, and AI/ML applications in climate studies.</li> </ul>

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Atmospheric Structure and Composition: Composition and vertical structure of the atmosphere, atmospheric layers, lapse rate, atmospheric stability, convection, geopotential height, pressure systems, air masses, global wind circulation, greenhouse effect.	6	Understand atmospheric structure, explain lapse rate and stability, analyze air masses, wind systems, and greenhouse effect.
2.	Atmospheric Dynamics and Environmental Processes: Atmospheric turbulence, planetary boundary layer, large-scale atmospheric circulation, clouds, precipitation mechanisms, hydrological cycle, water balance, aerosols, and atmospheric pollution.	5	Describe atmospheric circulation, cloud, and precipitation processes, and assess atmospheric pollution impacts
3.	Oceanography and Marine Systems: Continental and ocean-floor topography, physical and chemical properties of seawater, salinity and temperature distribution, residence time, ocean stratification, ocean currents, waves, tides, Ekman transport, ocean eddies, major oceanic water masses, marine pollution, and harmful algal blooms (HABs).	7	Understand ocean-floor morphology, seawater and stratification, analyze ocean currents, waves, and tides, assess marine pollution and HABs
4.	Air–Sea Interaction and Extreme Events: Air–sea fluxes, coupled atmosphere–ocean interactions, climate feedback mechanisms, Earth’s radiation and heat budget, Walker circulation, atmospheric and oceanic waves, hurricanes, tornadoes, and intensity scales of extreme events.	6	Explain air–sea interactions, understand climate feedback mechanisms, classify hurricanes and tornadoes
5.	Weather Systems and Indian Monsoon: Concepts of weather and climate, climate classification, climate indicators and indices, climate variability, Indian monsoon dynamics, tropical cyclones, jet streams, western disturbances, severe convective storms, and spatial distribution of rainfall over India.	8	Differentiate weather and climate, classify climate systems, analyze Indian monsoon dynamics,

			cyclones, jet streams, and rainfall variability
6.	Climate Variability and Climate Change: Sea-level and climatic variations across time scales, sea surface temperature variability, global and regional climate oscillations, ENSO, El Niño and La Niña impacts on monsoon, droughts and floods, cryosphere changes, climate modeling, global warming, and climate change science.	7	Understand climate variability and oscillations, explain ENSO and teleconnections, and assess the impacts of global warming.
7.	Emerging Technologies in Climate Science: Applications of Artificial Intelligence (AI), Machine Learning (ML), data analytics, predictive modeling, remote sensing, and computational tools in atmospheric, oceanic, and climate change studies.	3	Understand AI and ML applications in climate science, apply data-driven climate analysis, and explore computational tools.
	<b>Total Classes</b>	<b>42</b>	

**Text Book:**

1. Barry, R. G., & Chorley, R. J. (2009). Atmosphere, weather and climate (9th ed.). Routledge.

**Reference Books:**

2. Trujillo, A. P., & Thurman, H. V. (2016). Essentials of oceanography (12th ed.). Pearson.
3. Garrison, T. S., & Ellis, R. (2016). Essentials of oceanography (8th ed.). Cengage Learning.
4. McIlveen, R. (2010). Fundamentals of weather and climate (2nd ed.). Oxford University Press.
5. Aguado, E., & Burt, J. E. (2013). Understanding weather and climate (6th ed.). Pearson.
6. Marshall, J., & Plumb, R. A. (2007). Atmosphere, ocean, and climate dynamics: An introductory text. Academic Press.
7. Wells, N. C. (2009). The atmosphere and ocean: A physical introduction (3rd ed.). Wiley-Blackwell.
8. Wallace, J. M., & Hobbs, P. V. (2006). Atmospheric science: An introductory survey (2nd ed.). Academic Press.
9. Lutgens, F. K., Tarbuck, E. J., & Tasa, D. (2018). The atmosphere: An introduction to meteorology (13th ed.). Pearson.
10. Ahrens, C. D. (2015). Essentials of meteorology: An invitation to the atmosphere (7th ed.). Cengage Learning.
11. Ackerman, S., & Knox, J. A. (2011). Meteorology: Understanding the atmosphere (3rd ed.). Jones & Bartlett Learning.