DISCIPLINE SPECIFIC CORE COURSE – 8 (DSC-EVS-8): ATMOSPHERE & GLOBAL CLIMATE CHANGE

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
ATMOSPHERE & GLOBAL CLIMATE CHANGE	4	2	0	2	Class XII pass	NA

Learning objectives

The Learning Objectives of this course are as follows:

- Analyze dynamics of atmospheric processes, which include their composition, meteorological phenomena, and atmospheric chemistry.
- Gain knowledge on the development of the Earth's atmosphere, its dynamic nature, and variability in turns of the global energy balance.
- Describe air masses and formation and impacts fronts and how they affect local weather patterns,
- Develop a better understanding of the elements of the climate and climate change and human impacts on climate initiative policies.
- Train on different methods to understand the functioning of atmospheric processes and their importance in supporting life on Earth

Learning outcomes

After this course, students will be able to

- understand the underlying physical and chemical basis of the natural and anthropogenic greenhouse effect
- develop pathway analysis to develop linkages between various human-induced emissions of natural greenhouse gases and the formation of aerosols
- appreciate the variability in the Earth's climate and correlate the changing climate with different human activity
- critically evaluate the complexities and uncertainties about scientific evidence for climate change
- analyze Earth's past and Anthropocene and global climate
- correlate effects of global climate changes on human communities and impacts of policy and technology initiatives taken at global and regional levels to combat the climate change

SYLLABUS OF DSC-EVS-8

Theory (02 Credits: 30 lectures)

UNIT – I Introduction and Global Energy Balance (4 Hours)

Evolution and development of Earth's atmosphere; atmospheric structure and composition; significance of atmosphere in making the Earth, the only biosphere; Milankovitch cycles. Earth's energy balance; energy transfers in the atmosphere; Earth's radiation budget; greenhouse gases (GHGs); greenhouse effect; global conveyor belt.

UNIT –II Atmospheric circulation (5 Hours)

Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; *El Nino* and *La Nina*; tropical cyclone; Indian monsoon and its development, changing monsoon in Holocene in the Indian subcontinent, its impact on agriculture and Indus valley civilization; effect of urbanization on microclimate; Asian brown clouds.

UNIT –III Meteorology and atmospheric stability (4 Hours)

Meteorological parameters (temperature, relative humidity, wind speed and direction, precipitation); atmospheric stability and mixing heights; temperature inversion; plume behavior; Gaussian plume model.

UNIT –IV Atmospheric chemistry (4 Hours)

Chemistry of atmospheric particles and gases; smog – types and processes; photochemical processes; ions and radicals in atmosphere; acid-base reactions in atmosphere; atmospheric water; roles of hydroxyl and hydroperoxyl radicals in atmosphere.

UNIT –V Global warming and climate change (5 Hours))

Earth's climate through ages; trends of global warming and climate change; drivers of global warming and the potential of different greenhouse gases (GHGs) causing the climate change; atmospheric windows; impacts of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species, CO_2 fertilization and agriculture; impact on the economy and spread of human diseases.

UNIT –VI Ozone layer depletion (5 Hours)

Ozone layer or ozone shield; Importance of ozone layer; Ozone layer depletion and causes; Chapman cycle; Orocess of springtime ozone depletion over Antarctica; Ozone-depleting substances (ODS); effects of ozone depletion; mitigation measures and international protocols.

UNIT –VII Climate change and policy (3 Hours)

Environmental policy debate; International agreements; Montreal protocol 1987; Kyoto

protocol 1997; Convention on Climate Change; carbon credit and carbon trading; Clean development mechanism.

Teaching and learning interface for theoretical concepts

To achieve the course objectives and match with the contents, a wide range of teaching and learning tools will be employed, including (a) Formal lectures; (b) Interactive sessions using visual aid; (c) Case study analyses; (d) Hypothetical scenario building; (e) Group discussion on key topics; and (f) documentary screening and critical analyses.

Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)

1. Analyze the atmospheric chemistry of a given area with respect to target greenhouse gas(es) and its changes over time
2. Identify weather patterns and climate of the given region
3. Calculate the carbon footprint of the given institution (homes and/or college)
4. Evaluate the perception of climate change in developed and developing countries
5. Identify the critical factors governing global climate change and relate with the goals of different international governmental and non-governmental organizations

6-7. Compare the targets and achievements in global efforts to combat global climate change during the past three decades

8-9. Estimate the difference in carbon stock between soil and trees of a given area

10. Understand and correlate annual tree ring data with a historical account of climate
11. Identify the critical factors governing global climate change and relate them with the goals of different international governmental and non-governmental organizations
12. Compare climate change policies of selected developed and developing countries

Teaching and learning interface for practical skills

To impart training on technical and analytical skills related to the course objectives, a wide range of learning methods will be used, including (a) laboratory practicals; (b) field-work exercises; (c) customized exercises based on available data; (d) survey analyses; and (e) developing case studies; (f) demonstration and critical analyses; and (h) experiential learning individually and collectively.

Essential/recommended readings

- Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
- Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
- Hoffman, S., Eriksen, T.H. and Mendes, P. eds., 2022. Cooling Down: Local Responses to Global Climate Change. Berghahn Books.
- Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
- Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.

- Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
- Salby, M.L., 2012. Physics of the Atmosphere and Climate. Cambridge University Press.
- Speight, J.G., 2019. Global Climate Change Demystified. John Wiley & Sons.
- Wang, Y (2020). Atmosphere and Climate, 2nd Edition, Handbook of Natural Resources Vol VI, CRC Press.

Suggestive readings

- Crate, S.A. and Nuttall, M., 2016. Anthropology and Climate Change: From Actions to Transformations. Routledge.
- Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries with Policy and Science Considerations. Martinus Nijhoff Publishers.
- Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
- Hering, E., 2010. Atmosphere and Climate: Studies by Occultation Methods. Springer.
- Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition). Sage Publications.
- Sauer, T.J. and Norman, J.M. eds., 2011. Sustaining Soil Productivity in Response to Global Climate Change. Wiley-Blackwell.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.