

1. IDENTIFYING INFORMATION

Course title: **Energy and Climate Change**

Course code: **DMM - 201**

2. COURSE CONTENT

Unit-I Introduction: Climate change: Historical Perspective and overview; Skepticism Myths and reality of climate change, Green House Effect and Global Warming Causes and Consequences of Climate Change; Policies and Politics of Green House: conventions, treaties, negotiation; Energy: History of energy use; energy types; trends of energy use; Impact of energy on environment; observations and projections; Climate change and global issues; energy conservation; energy and climate change. ,

Unit-II Human influence on Climate: Anthropogenic activities affecting Climate: Industries, solid and E-waste; Energy consumption and energy audits; Trends in global carbon emissions; trend in projections for global climate in different time scale.

Unit-III Energy Systems and Emissions: Technological change and energy consumption in industry; Role of energy crisis in climate change; Transition to renewable energy: options, costs and benefits; Emerging and future energy sources. Policy Response.

Unit-IV: Energy and Climate Protection: Energy and Climate Protection: International approaches to cope up climate change: conventions (UNFCCC), Agreements (The Paris Agreement-2005), Protocols (Kyoto protocol etc). Climate change mitigation in developing countries; Public and Private sector role in climate change in India.

Suggested Readings:

1. McElroy, Michael B (2010): Energy: Perspectives, problems and Prospects, New York: Oxford University Press.
2. Elliot David (1997): 'Sustainable technology', Energy Society and environment. New York, Routledge.
3. Naomi Klien (2014): This Changes Everything: Capitalism versus Climate.
4. Edmond Mathez (2009): Climate Change: The Science of Global Warming and Our Energy Future. Columbia University Press.
5. Schmidt et al (2009): Climate Change: picturing the Science. WW Norton and Company.

1. IDENTIFYING INFORMATION

Course title: **Economics of Climate Change**

Course code: **DMM – 202**

UNIT-I

Climate Change: Economics, Ethics and Development Challenges; The Implication of Emission on Climate Change; Climate Treaties and Importance of Enforcement; Climate Change a Critical Analysis.

Unit-II

Climate Change and Economic Development: Effects and Implications on Development; Climate Change and Inequality; The Challenge of Stabilization; Trends in Global Carbon Emission, Trends and Projection for Global Climate; Impact of climate change on Business and Trade; Reversing Emissions from Landuse Changes; Effect of Weather Shocks on Agricultural Prices; Effect of Weather and Climate on Mortality Rates.

Unit-III

The Economics of Climate Change: Economics and Climate Protection; Cost Benefit Analysis; Understanding the Economics of Adaptation in Developed and Developing World; Identifying Cost of Mitigation in Developed and Developing Nations; Carbon Pricing and Emission Markets in Practice; Role of Energy Prices in Global Climate Change; Beyond Carbon Markets and Technology.

Unit-IV

Climate and Development Policy: A State of Change; Financing the Development Response to Climate Change; Carbon Taxes; Emission Trade Permits; Subsidies; Technology transfer; Designing Climate Mitigation Policy; From Negotiation to Implementation: UNFCCC and its Kyoto Protocol.

Suggested Readings:

1. Stern N (2007): The Economics of Climate change. The Stern Review, Cambridge, Cambridge University Press.
2. Nordhaus W. (1977) Economic Growth and Climate: The Case of Carbon Dioxide. The American Economic Review, 67(1), 341-346.
3. Newell RG and Pizer WA (2003): Discounting the Distant Future. How Much do Uncertain Rates Increase Valuation. Journal of environmental economics and Management Vol. 46, pp. 52-71.
4. Frankhauser S, Tol R and Pearce D (1997): The Aggregation of Climate Change Damages: A Welfare Theoretic Approach. Environmental and Resource Economics. Vol.10 pp. 249.66.
5. Helm D and Hepburn C (2009): The Economic and Politics of Climate Change. Published to Oxford Scholarship Online.

1. IDENTIFYING INFORMATION

Course title: **Climate Change and Global Sustainability**

Course code: **DMM – 203**

UNIT-I Climate Change: Observation of Climate Change; Changes in patterns of temperature, precipitation and sea level rise, Observed effects of Climate Changes, Drivers of Climate Change; Climate Sensitivity and Feedbacks; The Montreal Protocol, UNFCCC, IPCC; Evidences of Changes in Climate and Environment: Global Scale and in India.

UNIT-II Climate Change Impacts and Responses: Overview of climate change impacts, Climate change and its impact on: water resources, world food production, marine ecosystem and marine resources; vulnerability of coastal zones. Impact of climate change on Business and Trade.

UNIT-III

Impacts Of Climate Change on: Air (ozone depletion, smog), Landuse changes, Waste generation (treatment, e-waste), Human Health; Industry, Settlement and Society; Projected Impacts for Different Regions; Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT-IV

Climate Change Adaptation and Mitigation Measures: Adaptation Strategy/Options in various sectors – Water, Agriculture, Infrastructure and Settlement including coastal zones, Human Health, Tourism, Transport – Energy – Key Mitigation Technologies and Practices: Energy Supply, Transport, Buildings, Industry, Agriculture, Forestry, Carbon sequestration, Carbon capture and storage, Waste (MSW and Bio waste, Biomedical, Industrial waste. International and Regional cooperation. Future vision of sustainable society

Suggested Readings:

1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002.
2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998.
3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998.
4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfer P. R. et. al (ed.), Edward Elgar, 1996.
5. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

1. IDENTIFYING INFORMATION

Course title: **Global Climate Modeling**

Course code: **DMM – 204**

UNIT-I

Ocean Circulation and Climate Overview; Driving Mechanism and Components: Upper and Lower Ocean Circulation; thermohaline circulation; Impact of Climate Change on Oceanic Circulation; Oceanic General Circulation model (GECM).

UNIT-II

Climatic Change and Global Climate Modeling an Overview; Need for Global Models; Components of Global Climatic Models (Atmosphere and Hydrosphere); Governing Factors; Methodology for Climate Modeling; Scientific Basis of Prediction and Forecasting of Climate Change; Climate modeling: Global Climate Models, Earth system model Regional Climate model, Ocean Circulation Model, and modeling of monsoon system.

UNIT-III

Global and Regional climate model: use of Coupled Models to simulate the global and regional climate; Statistical and Dynamical downscaling of regional model; Results to a better Spatial Resolution; Global and Regional Climate Scenarios for Impact Modeling Studies; Global and Regional Climate Prediction: Seasonal and Decadal; Model Simulation: Projected Climate Change Scenarios and their Underlying Uncertainties.

UNIT –IV

Modeling of Monsoon System: The Origin of Monsoon; Global and Indian Monsoon System; Dynamic Weather prediction Model; Multiple Linear Regression Model .

Suggested Readings:

1. Schnoor, J.L. (1996): Environmental Modeling. John Wiley & Sons, Inc., New York.
2. Randall DA and Wood RA (NA): Climate models and their evaluation. Chapter-8.
3. Chapra, S.C. (1997). Surface Water-Quality Modeling. McGraw-Hill International Edition.
4. Schnelle, K. B. and Dey, P.R. (1999). Atmospheric Dispersion Modeling Compliance Guide. McGraw-Hill.
5. David N (2011): Climate change and climate modeling, 1st Edition, Cambridge University press.
6. Marilyn AB and Benjamin KS (2011): Climate change and global energy security: technology and policy options.

1. Identifying Information

Course Title: Predictive Modeling for Micro Climatic Regions

Course Code: DMM-205

2. Course Content

Credits: 4

UNIT-I: Fundamentals of Micro Climate

Defining Micro Climates; Different types of Microclimates: Rural and urban, Desert, Himalayan; Koppen Classification for climatic Zones; Indian Climatic Zones based on Koppen classification.

UNIT-II: Urban Micro Climate

Urbanization and its impact on micro climates; urban heat islands: causes and effects; Risk and Vulnerability of Urban Population; Urban micro climate zonation for sustainable smart city planning, Case study of plume dispersion, urban heat.

UNIT-III: Urban Heat Islands

Research on heat islands globally and in India; Use of remote sensing and GIS in detecting urban heat islands; Data collection: Landuse /Landcover, Hydro meteorological (Temperature, Rainfall, Humidity, Wind), Elevation.

UNIT-IV: Urban Climate Modeling

Modeling: Microclimates and Urban Flooding, Urban Heat Island; Microclimate model 'ENVI-met'; a 'SOLWEIG'.

DMM- 206 Mapping and Analysis of Climatic Data

M.Sc. Disaster Management

Unit -I: Weather instruments and data sources

Use of weather instruments: Thermometer; Barometer; Wind vane; Rain gauge; Data sources: Indian Meteorological Department; AWS, National Remote Sensing Centre; United States Geological Survey; Google Earth.

Unit - II: Data analysis

Interpretation of weather data: Temperature; Humidity; Rainfall; Pressure; Wind speed and direction. Statistical time series analysis: Actual trend; Semi average; Moving average; Linear trend by least square method

Unit-III: Representation of Data

Synoptic charts; Climatic data representation: Iso-lines; Line graphs; Wind roses; Climograph; Rainfall dispersion diagram; Ergograph

Unit IV: Mapping

Indian Weather Map; Mapping from point data: Rainfall; Temperature; Pressure. Mapping and analysis of microwave data

Books recommended

1. Misra, R. P., & Ramesh, A. (1989). *Fundamentals of Cartography*. Concept Publishing Company
2. Armstrong, L. (2015). *Mapping and modeling weather and climate with GIS*. Esri Press.
3. Dobesch, H., Dumolard, P., & Dyras, I. (Eds.). (2013). *Spatial interpolation for climate data: the use of GIS in climatology and meteorology*. John Wiley & Sons.
4. Singh, R. L., & Dutt, P. K. (1951). *Elements of practical geography*. Students' Friends.

DMM- 207 Geospatial modelling in Climate Studies

M.Sc. Disaster Management

Unit -I: Geospatial data for climate study

Weather map; thematic maps of weather elements; IMD data products; Satellite data products: Landsat; MODIS; NOAA, INSAT series

Unit - II: Characteristics and management of data

Spectral characteristics: Atmospheric window of EMR; Availability of spectral bands on satellite data products. Spatial coverage; Revisit time of sensors; Management of non-spatial data: data conversion; attribute handling; preparing thematic layer from non-spatial weather data.

Unit-III: Geospatial models (Any two)

Temperature models: Land surface temperature; Sea surface temperature; air diurnal temperature cycle. Precipitation estimation; Hydro-climatic simulation by precipitation data; Climate variability; Vegetation dynamics; Evaporation measurement; Aerosol optical depth; Model validation through in situ data

Unit IV: Applications (Any two)

Air pollution; Flood; Urban micro climate; Dust storms; Cyclone; Volcanic eruptions; Forest fires

Books recommended

1. Carleton, A. M. (1991). *Satellite remote sensing in climatology*. Belhaven Press.

2. Beniston, M., & Verstraete, M. M. (Eds.). (2001). *Remote sensing and climate modeling: synergies and limitations*. Kluwer Academic Publishers.
3. Vaughan, R. A. (Ed.). (2012). *Remote sensing applications in meteorology and climatology* (Vol. 201). Springer Science & Business Media.
4. D'Almeida, G. A., Koepke, P., & Shettle, E. P. (1991). *Atmospheric aerosols: global climatology and radiative characteristics*. A Deepak Pub.
5. Carrega, P. (Ed.). (2013). *Geographical information and climatology*. John Wiley & Sons.

Suggested sites:

1. <https://mosdac.gov.in/content/Mission/insat-3d>
2. <https://www.ncdc.noaa.gov/data-access/satellite-data>