

## Climate Change, Weather Forecasting and Early Warning System (Elective)

<b>Code</b> DM-819	<b>Credit Hours</b> 3 – 0
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### **Course Description:**

Aims to give students basic understanding of concepts related to climate and weather, climate and weather models and early warning systems. It also focuses on response to climate change and adaptation planning. The course aims at providing students' firsthand information on the climate forecasting capabilities of Pakistan through lectures by Guest Speakers from Pakistan Meteorological Department (PMD) and visits to PMD.

### **Course Content:**

<b>Topics</b>	<b>Learning Outcomes</b>
Introduction to atmosphere and energy balance	Basic concepts of energy dynamics in the atmosphere
Atmosphere and forces acting on atmosphere, Meteorological Parameters	Understanding meteorological parameters and their horizontal and vertical variations, and forces driving the energy balance in the atmosphere
Introduction to Weather and Climate Change, Causes of Climate Change and indicators	Climate change as a recent concept, its drivers and indicators. Recent climate change impacts on local, regional and global scales
National Climate Change Policy, International Agreements and Protocols and related National policies	Understanding IPCC and UNFCCC, etc. IPCC Special report on Emissions Scenarios (SRES)
Climate Change adaptation and mitigation	Mitigation and adaptation practices for climate resilience. Planning and execution at community,

	districts, province and country levels in Pakistan
Weather and Climate Models, Global and Regional Climate Models	Basic parameters of Climate Forecasting, El Nino and La Nina, North Atlantic Oscillations, Monsoon patterns, Types of weather and climate prediction techniques, Primitive equation models, Initial and boundary conditions, Global and regional Climate models
Predictability and uncertainties in weather and climate prediction	Basic and advanced concepts regarding weather and climate forecasting, Chaotic nature of weather phenomenon and forecast uncertainties associated with this
Early warning system	Risk identification and assessment, generation of early warning from weather forecasts, dissemination and communication of early warning information
Data driven forecasting using statistical techniques	Modern-era ensemble prediction system (EPS)
Case Studies, Term Project	

**Textbooks:**

No textbook for this course. The course will be based on different reference books, reports, and conference and journal publications.

**Reference Material:**

1. James R. Holton (1992): An Introduction to Dynamic Meteorology, Third Edition, Academic Press, New York
2. Washington W.M., Parkinson, C.I. (2000): An Introduction to Three-Dimensional Climate Modelling, Oxford University Press, Oxford
3. Burroughs, W.J. (2007): Climate Change: A Multidisciplinary Approach, Cambridge University Press, Cambridge (second edition)

4. Smith et al. (2009): Assessing dangerous climate change through an update of the Intergovernmental Panel on Climate Change (IPCC) “reasons for concern,” Proc. National Academy of sciences of USA. Vol 106(1), p. 4133-4137.
5. Lenton et al. (2008): Tipping elements in the Earth’s climate system, Proc. National Academy of sciences of USA. Vol 105(6), p. 1786-1793.
6. Meadows, D.H. (1999): Leverage Points: Places to Intervene in a System, The Sustainability Institute Hartland USA
7. Newell, B, & Proust, K. (2009): I See How You Think: Using Influence Diagrams to Support Dialogue
8. Proust, K, and Newell, B. (2006): Catchment and Community: Towards a management focused dynamical study of the ACT water system, Final Report, Actew Project WF-30038, ANU
9. Reid Basher (2006): Global early warning systems for natural hazards: systematic and people centred. Philosophical Transactions of the Royal Society, 364, p. 2167-2182.

**Pre-requisite:** Preferably students with engineering / science background

#### **Assessment System**

Quizzes	15%
Assignments	10%
Mid-Semester Exam	25%
Term Project/Paper	10%
End Semester Exam	40%