Course title: Introduction to Climate Modelling

Course code: NRC 122	**No. of credits:** 3	**L-T-P: 31**-10-8	**Learning hours:** 45

Pre-requisite course code and title (if any): Environmental Statistics

Department: Energy and Environment

Course coordinator(s):	**Course instructor(s):** Mr Saurabh Bhardwaj

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Course type: Elective	**Course offered in:** Semester 2

Course description

On completion of this course, students should be able to understand fundamental principles of climate science depicted in the models, various types and usage of modelling activities, and basic programming required to obtain modelling skills. The lectures will lead to basic understanding of atmospheric processes, modelling framework under IPCC working papers and case studies involving usage of modelling into impact studies.

Course objectives

The objective for this courses it to introduce postgraduate students to the principles of climate and Earth System modelling and aspects of climate simulation.

Course content

Module	**Topic**	**L**	**T**	**P**
1.	Fundamental Forces Pressure Gradient Force, Centrifugal Force, Gravity Force, Coriolis Force	4	2	
2.	Numerical Weather Prediction (NWP) Fundamental equations of fluid motion in rotating and non-rotating fluid in different coordinate system, Principle of Weather Forecasting, General Circulation of atmosphere and Ocean, Kinematics & Circulation of pressure field and its application	6	4	
3.	Introduction to Climate Models a. Basics of models i. Concept of Parameterizations, time-stepping and resolution b. Framework and process of model simulations c. Types of Models d. Uncertainties and sensitivity e. Case Studies	8	2	
4.	Introduction to Climate processes a. Basic understanding on Climate Sciences b. Uncertainty c. IPCC and working Group 1 projections: Global to Regional aspects d. Case Studies – illustrations	6	2	
5.	Introduction to Linux operating system and FORTRAN programming, GrADS concepts and data analysis	7		8
	Total	**31**	**10**	**8**

Evaluation criteria

- Test 1: 20%
- Test 2: 20%
- Test 3: 60%

Learning outcomes

At the end of the course, the student should be

- Able to explain different forces influencing the climate system
- Describe principles behind use of appropriate model inputs and outputs
- Able to understand fundamentals of NWP models and its applicability

Pedagogical approach
Class room teaching with few hands-on exercises on programming

Materials

Required text

1. Goosse H., Barriat P.Y., Lefebvre W., Loutre M.F. and Zunz V., Introduction to Climate Dynamics and Climate Modeling.
2. James R.H. An Introduction to Dynamic Meteorology, International Geophysics Series
3. Steven A. Ackerman and John A. Knox, Meteorology Understanding the Atmoshere

Suggested readings

1. Geoffrey K.V. Atmospheric and Oceanic Fluid Dynamics: Fundamentals and Large-scale Circulation.
2. Jacobson M.Z. Fundamentals of Atmospheric Modeling.
3. McGuffie K. (Henderson-Sellers A., A Climate Modelling Primer, John Wiley & Sons.
4. Taylor F.W. Elementary Climate Physics.
5. Washington W.M. and Parkinson C.L.Introduction to Three-dimensional Climate Modeling

Websites

1. IPCC (2001 & 2007) Working Group I Report "The Physical Science Basis"

Journals

1. Geophysical Research
2. Global Environmental Change
3. Climate Dynamics
4. Current Science

Advanced Reading Material

Additional information (if any)
Regular Assignment and reading will be given on weekly basis

Student responsibilities
The students are expected to submit assignments in time and come prepared with readings when provided.

Course Reviewers

1. Dr. Madhusoodanan M.S., Associate Professor, Amrita University.
2. Prof A K Dimri, School of Environmental Sciences, Jawaharlal Nehru University, New Mehrauli Road, New Delhi.