IIT Mandi
Proposal for a New Course

Course Name: Special topics in Atmospheric Modelling
Course Number: CE 591
Credit: 1
Students intended for: B.tech/MS/ Ph.D.
Elective or Compulsory: Elective
Semester: Odd

Preamble:

This course explores the numerical modelling approach to understand complex atmospheric phenomena. The other possible approaches could be observational studies of the real atmosphere through field measurements and remote sensing, laboratory studies, and theoretical studies. The objective of this course to provide understanding of how numerical modelling approach solves the evolving atmospheric processes. In this regards basic principles of the space and time discretizations used in atmospheric models will be introduced. The practical understanding of the choice of the discretization methods (time/space) will be provided by solving simple equations like advection equation (for temporal discretization) and diffusive wave equations for (spatio-temporal equation). As typical atmospheric models constitute of number of spatio-temporal equations, this course provide background for running any regional/global model. The same will be achieved by introducing to the numerics of the well–known WRF model and the working knowledge of simulating real atmosphere with WRF model be provided.

Learning outcomes of this course are anticipated as follows:

- **Basic principles of grid point models used in atmospheric science**
- **Numerical discretization of the grid point models.**
- **Working knowledge of writing models for simplified atmospheric flows e.g advection, diffusive –wave equation**
- **Working knowledge of fully comprehensive grid point atmospheric model e.g. WRF model.**

Modules

	Contents	Contact Hours
1	**Grid Point Model :** Introduction to global and regional models	2
2	**Time Integration Scheme :** Forward, Backword, Matsuno, Runge Kutta, Adam Bathforth and models based on these schemes	2
3	**Space Differencing Scheme** : Centered, un-centered, computational dispersion, Focus of advection equation and effect of using different schemes on solution of advection equation	3
4	**Solving Spatio-temporatal euations:** Flood Model (Diffusive Wave Equations) , WRF Model (Complete WRF model Equations)	3
5	**Lab: 2.5 hours X 2 lab ≈ 4 lectures hours** - **writing and running simple solutions of advection equation using different time discretization schemes** - **writing solution of diffusive –wave equation and running a sample code of dam break problem based on this spatio-temporal equation. This lab will give understanding of effect of spatial discretization** - **Introduction and working knowledge of real atmospheric model (WRF-ARW)**	4
	Total	14

Suggested books:

Jacobson, Mark Z. Fundamentals of atmospheric modeling. Cambridge university press, 2005.

Mesinger, F., and A. Arakawa, 1976: Numerical methods used in atmospheric models. *GARP Publ. Ser. No. 17*.

Randall, D. A., Ed., 2000: *General Circulation Model Development. Past, Present, and Future*. Academic Press, 807 pp

Durran, D. R., 1999: *Numerical methods for wave equations in geophysical fluid dynamics*. Springer.

Haltiner, G. J., and R. T. Williams, 1980: *Numerical prediction and dynamic meteorology*. J. Wiley and Sons.

Other Faculty Members interested in teaching this course: None

Proposed by: Dr. Rashmi Mittal

IBM Research, Delhi

Signature_____ _ Date____14-8-2017_____

The course proposal has been duly circulated and comments are attached/ no comments were received.

_____(Dean (Academics)) Date:_____

Approved / Not Approved

_____ Date:_____
Chairman, Senate