Introduction to Atmospheric Science - Video course

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Mechanical Engineering

Coordinators:

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COURSE OUTLINE

Introduction: The components of the climate system- oceans, cryosphere, terrestrial biosphere, earth's crust and mantle, Role of various components in climate, Hydrological cycle, Carbon cycle, Brief history of climate and the earth system
Atmospheric thermodynamics: Gas laws, Hydrostatic equation, First law, Adiabatic processes, Water vapour in air, Static stability, Second law and entropy, atmospheric dispersion
Radiative transfer: EM spectrum, Radiation laws, Physics of absorption, emission and scattering, Radiative transfer in atmosphere, Planetary radiation budget, Introduction to Remote Sensing
Atmospheric Dynamics: Equations of motion, Geostrophic approximation, Atmospheric General Circulation
Atmospheric Boundary Layer: Surface energy balance and bulk aerodynamic formulae- Vertical structure
Climate dynamics: Present day climate- Climate variability – Climate sensitivity and feedback – Global warming – Climate monitoring and prediction

COURSE DETAIL

Lecture Number	Lecture Topic
Introduction and Earth system	
1	Atmosphere-A brief survey (Pressure, Temperature and Chemical composition)
2	Atmosphere-A brief survey contd … (Vertical structure of the atmosphere)
3	The Earth system - Oceans
4	The Earth system – Marine biosphere
5	The Earth system – Hydrological cycle

6	The Earth system – Carbon cycle
7	The Earth system – Carbon in the oceans and Earth's crust
Atmospheric Thermodynamics	
8	Atmospheric Thermodynamics- Introduction
9	The hydrostatic equation
10	Hypsometric equation and pressure at sea level
11	Basic Thermodynamics
12	Concept of air parcel and dry adiabatic lapse rate
13	Potential temperature and problems
14	Skew-T ln-P chart
15	Lifting Condensation Level (LCL)
16	Saturated adiabatic and Psedo-adiabatic processes
17	Saturated adiabatic lapse rate
18	Tutorial on using Skew-T ln-P chart
19	Normand's rule and static stability
20	Stability contd... (Brunt-Vaisala frequency)
21	Conditional and convective stability
22	Second law of Thermodynamics – Clausius-Clayperon equation

Radiative transfer	
23	Atmospheric radiation- Introduction
24	Quantitative description of radiation
25	Concept of Black body and Stefan-Boltzmann law
26	Radiative properties of non-black surfaces
27	Kirchoff's law
28	Physics of Absorption, Emission and Scattering in the atmosphere
29	Physics of Absorption, Emission and Scattering in the atmosphere Contd...
30	Equation of Radiative Transfer (RTE)
31	Radiative cooling rates
Atmospheric Dynamics	
32	Atmospheric Dynamics – An Introduction
33	Hydrostatic and Geostrophic approximations
34	Cyclostrophic approximation and Thermal winds
35	Tutorial on atmospheric dynamics
Atmospheric boundary layer	
36	Surface energy balance and bulk aerodynamic formulae
37	Vertical structure
Climate Dynamics	

38	Climate Dynamics – Introduction
39	Climate sensitivity and feedback
40	Transient and equilibrium response
41	Tutorial on climate dynamics and feedback
42	Summary

References:

1. Atmospheric science – An Introductory Survey, J.M.Wallace and P.V.Hobbs, 2nd Edition, Academic Press, London, 2006.
2. The Physics of Atmospheres, John Houghton, 3rd Edition, Cambridge University Press, Cambridge, 2002.
3. An Introduction to Atmospheric Thermodynamics, A.A.Tsonis, 2nd Edition, Cambridge University Press, Cambridge, 2007.
4. An Introduction to Dynamic Meteorology, J.R.Holton, 4th Edition, Academic Press, London, 2004.
5. A Climate Modelling Primer, K.McGuffie and A.Henderson-Sellers, 3rd Edition, John-wiley, New York, 2004.
   Climate Change 2007 – The Physical Science Basis, IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, 2007.