Physics of Atmosphere and Ocean - Web course

NP-TEL

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Atmospheric Science

COURSE OUTLINE

The entire lecture course, consisting of 12 Modules, introduces to an entrant basic meteorology and oceanography, atmospheric thermodynamics, ocean physics, radiative transfer in the atmosphere and heat-induced tropical circulations. Topics in each module have several excellent textbooks, which the Instructor has followed in preparing these lectures. Each module is founded on basic subject knowledge and provides a fundamental understanding of concepts discussed therein. Solved examples are also an integral part of this course and several exercises have been added. By working out these exercises, a learner can understand the science of meteorology and oceanography fairly independently. Most of the problems are standard practice problems that can be worked out after a thorough study of topics in these lecture notes but a few of them are designed by the Instructor himself to analyse, for example, the radiosonde ascents of India Meteorology Department and Argo float profiles in the Indian Ocean from Indian National Centre for Ocean Information Services. These lecture notes have grown out of a course on this subject given to M.Tech students by the Instructor at IIT Delhi. The first two modules cover basic meteorology and oceanography; while atmospheric thermodynamics, ocean physics and atmospheric radiation are each covered in three modules. The heat-induced tropical circulation has been introduced and expounded subsequently in a single module to provide a theoretical understanding of Walker circulation, El Nino Southern Oscillation (ENSO), Southwest Indian summer monsoon (ISM), and the Maddan-Julien Oscillation (MJO). By a proper selection of mudules, a student may learn this subject fairly independently from a basic knowledge of calculus and the first order non-homogeneous ordinary differential equations. Every teacher has his preference of organizing his lecture course, so here too the Instructor has sequenced the modules according to his choice. After gaining an understanding of the of the basic principles, an ambitious student can directly gain an insight into the parametrization of convection, radiation and ocean processes by using or learning numerical methods, computing techniques, computer languages and supercomputing. Matlab is also a popular computing platform; therefore, students are encouraged to solve the problems in assignments using Matlab wherever necessary. Some problems can be used to develop simple computer programs in Fortran, C or any other programming language, which can be combined into one computer program to solve higher level practical problems that are indeed topics of numerical modelling.

Valuable suggestions are welcome from the readers and may be given through the feedback on this course to the Instructor.

COURSE DETAIL

S.No	Modules	Lecture/ Topics
1	Module 1	The Atmosphere and Ocean
2	Module 2	Elements of Basic Meteorology and Oceanography
3	Module 3	Thermodynamics of the Dry Atmosphere
4	Module 4	Water Vapour in the Atmosphere

Pre-requisites:

Calculus , Desirable: Basic Fortran and C / C++ Ordinary differential equations, Partial differential equation.

Additional Reading:

1. Meteorology for Scientists and Engineers, R.B. Stull, Brooks/Cole 2000
2. Atmospheric and Oceanic Fluid Dynamics, G.K. Vallis, Cambridge University Press 2006
3. Principles of Physical Oceanography, G.Neumann and W.J. Pierson, Prentice- Hall 1966
4. Atmosphere-Ocean Dynamics, A.E. Gill, Academic Press 1982
5. Dynamics of Atmospheric Motion, J.A. Dutton, Dover Publication 1986
6. Thermodynamics

5	Module 5	Energy Diagrams
6	Module 6	Ocean Thermodynamics
7	Module 7	Adiabatic Effects in the Ocean
8	Module 8	Ocean Circulation and Surface Processes
9	Module 9	Radiative Transfer in the Atmosphere
10	Module 10	More Complex Radiative Transfer in the Atmosphere
11	Module 11	Radiative Heating in the Atmosphere
12	Module 12	Heat-induced Tropical Circulations in the Atmosphere

References:

1. The Physics of Atmospheres, J.T. Houghton, Cambridge University Press 2007
2. An introduction to Atmospheric Physics, D.G. Andrews,Cambridge University Press 2000
3. Atmospheric Science, J.M. Wallace and P.V. Hobbs,Elsevier / Academic Press 2006
4. A Short Course on Cloud Physics, RR Rogers and MK Yau,Butterworth-Heinemann Publication 1996
5. Atmospheric Thermodynamics, J.V. Iribarne and W.L.Godson, D.Reidel Publishing Company. 1973
6. Physics of the Atmosphere and Climate, ML Salby,Cambridge University Press 2012
7. Introduction to Dynamic Meteorology, J.R. Holton,Academic Press 2004
8. Elements of Physical Oceangraphy, H.J. McLellan,Pergamon Press 1965
9. Principles of Ocean Physics, J.R. Apel, Academic Press 1987
10. Ocean circulation Physics, M.E. Stern, Academic Press 1975
11. An Introduction to Physical Oceanography, W.S. Von Arx, Addition-Wesley Publishing Company 1974
12. Atmosphere, Ocean and Climate Dynamics: An Introductory Text, J. Marshall and R.A. Plumb, Elsevier Academic Press 2008
13. Atmosphere-Ocean Interaction, EB Kraus and JA Businger, Oxford University Press 1994
14. An Introduction to Atmospheric Radiation, KN Liou,Academic Press 2002
15. Global Physical Climatology, D.L. Hartmann, Academic Press 1994
16. The Atmosphere and Ocean: A Physical Introduction (Advancing 2012¸Weather and Climate Science), N.C. Wells, Wiley Blackwell.

of Atmospheres and Oceans, J.A. Curry and P.J. Webster, Academic Press 1999

Coordinators:

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