Indian Institute of Technology, Kanpur

Proposal for a New Course

1. Course number: CE 7XX

2. Course title: Hydrometeorology

3. Per week: Lectures – 3(L), Tutorial – 0(T), Laboratory – 0(P), Additional hours: 0(A)

Credits: 3-0-0-0 (9)

Duration of course: Full semester

4. Proposing department/IDP: Civil Engineering

Other Departments/IDPs which may be interested in the proposed course: Earth Sciences, School of Sustainability

Other faculty members interested in teaching the proposed course: None

5. Proposing instructor: Tushar Apurv

6. Course description: PG course/department elective

A. Objectives

The objective of this course is to provide a conceptual understanding of the physical processes involved in the transfer of water and energy between the land surface and the lower atmosphere. The course will focus on fundamental concepts such as laws of thermodynamics and mass, momentum, and energy conservation principles to explain hydrometeorological processes such as rainfall, cloud formation, evapotranspiration, winds and development of pressure systems. The understanding of these processes will further be applied to explain hydrometeorological phenomena such as extreme rainfall, thunderstorms, floods, droughts and heatwaves.

B. Contents

S. No.	Broad title	Topics	No. of lectures
1.	Introduction	Overview of the field of hydrometeorology and its applications	1
2.	Water vapor and its properties	Specific humidity, saturation vapor pressure, dew point temperature, wet and dry bulb temperature, relative humidity, adiabatic lapse rate of moist air	2
3.	Precipitation	Thermodynamic diagrams, lifting of dry and saturated air, static and dynamic stability, parcel method for stability analysis, cloud formation and precipitation, types of storms	4
4.	Weather maps	Symbols used in weather maps and their interpretation	2
5.	Atmospheric forces and winds	Forces acting on air: pressure gradients, centrifugal force, Coriolis force, drag force, equations of motion, types of winds: geostrophic winds, gradient winds,	6

		atmospheric boundary layer wind, cyclostrophic winds	
6.	General circulation	Global radiation budget, Hadley cells, thermal winds, circulation in low-, mid- and high-latitudes, monsoon, jet streams, Rossby waves	6
7.	Fronts and airmasses	Warm and cold air masses, surface fronts, occluded fronts, mid-tropospheric fronts, upper-tropospheric fronts, extratropical cyclones	6
8.	Thunderstorms	Conditions for thunderstorm formation, Convective Available Potential Energy, wind shear, convective inhibition and triggers	5
9.	Atmospheric boundary layer	Temperature and wind profiles, diurnal variations, turbulence, mixing length theory	3
10.	Evapotranspiration	Surface layer scaling, aerodynamic resistance, canopy resistance, estimation of evapotranspiration	5
Total			**40**

C. Pre-requisites: (CE361 and CE261) or (CE610 and CE611)

D. Short summary for including in the Courses of Study Booklet: Energy and water budget of land surface and lower atmosphere, properties of water vapor, atmospheric stability, cloud formation and precipitation, weather maps, atmospheric forces, geostrophic winds, gradient winds, general circulation of atmosphere, monsoons, jet-streams, Rossby waves, warm and cold fronts, thunderstorms, atmospheric boundary layer, aerodynamic and canopy resistance, evapotranspiration.

7. Recommended books:

Reference books:

Ahrens, C. D., & Henson, R. (2018). Essentials of meteorology: An invitation to the atmosphere.

Stull, R. B. (2015). Practical meteorology: an algebra-based survey of atmospheric science. University of British Columbia.

Shuttleworth, W. J. (2012). Terrestrial hydrometeorology. John Wiley & Sons.

8. Any other remarks: none

Proposer: Tushar Apurv
Dated: 05-04-2024

DPGC convener:
Dated:

The course is approved/not approved.
Chairperson, SPGC
Dated: