

CE 520 PHYSICAL HYDROLOGY

INSTRUCTOR

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Office Hours: MWF 10:00 - 11:00 AM - A222 Engineering Bldg.

Web page: http://www.engr.colostate.edu/~ramirez/ce_old/classes/ce520_ramirez/

TEXTBOOKS AND REFERENCES

1. *Hydrology, an Introduction to Hydrologic Science* by R. L. Bras. Addison Wesley, 1990.
2. *Dynamic Hydrology* by Peter S. Eagleson. McGraw Hill, 1970.
3. *Physical Hydrology* by L. S. Dingman. Upper Saddle River, N.J.: Prentice Hall, 1994.
4. *Applied Hydrology* by V. T. Chow, D. Maidment, and L. W. Mays. McGraw Hill, 1988.
5. *Atmospheric Science, an Introductory Survey* by J. Wallace and P. Hobbs. Academic Press, 1977.
6. *Physical Climatology* by W. D. Sellers. The University of Chicago Press, 1974.
7. *Hydraulics of Groundwater* by J. Bear. McGraw Hill, 1979.
8. *Introduction to Hydrology* by W. Viessman, J. Knapp, G. Lewis, T. Harbaugh. Crowell, Harper and Row, 1977.
9. *Hydrology for Engineers* by R. Linsley, M. Kohler, and J. Paulhus. McGraw Hill, 1975.
10. Class handouts.

COURSE OBJECTIVES

This course emphasizes process understanding from a physical point of view. Interdisciplinary aspects of hydrologic science are presented in a unified framework. Topics include: Earth's energy budget: radiation physics, shortwave and longwave radiation. Earth/Atmosphere system: atmospheric composition and structure; atmospheric moist thermodynamics. Precipitation, evaporation and transpiration, infiltration and exfiltration, snow hydrology, and surface and groundwater runoff. Linear system theory and hydrologic response. Geomorphology. Global and large-scale hydrology.

METHODOLOGY

Intensive student participation. In-class discussions of current issues. Individual paper reviews. Suggested readings are given in the syllabus and in the attached reading reference list.

SCHEDULE

Lecture: MWF - 9:00 - 9:50 AM - NESB B-101

CE 520 PHYSICAL HYDROLOGY**COURSE OUTLINE**

TOPIC

Introduction

Introduction to Hydrologic Science: Hydrology, a distinct geoscience.
 The global hydrologic cycle.
 Multidisciplinary hydrology and its relation to other geosciences

Earth's Energy Budget

Surface radiation distribution.
 Elementary radiation physics.
 Short wave radiation.
 Long wave radiation.

Earth-Atmosphere System

Atmospheric composition and structure.
 Pressure, temperature, moisture distributions.
 Principles of atmospheric thermodynamics.
 Principles of atmospheric stability.

Precipitation

Rainfall generating mechanisms.
 Cloud physics.
 Storm structure.
 Precipitation modeling. Applications.

Evaporation and Transpiration

The lower atmosphere and the atmospheric boundary layer (ABL).
 Mean profiles and similarity in a stationary and horizontally uniform ABL.
 Evaporation process.
 Water and energy balance methods.
 Mass transfer method.
 Penman equation.
 Transpiration. Evapotranspiration.
 Modified Penman equation.

Sub-Surface Hydrology - Infiltration and Exfiltration

Flow in unsaturated porous media
 Infiltration and exfiltration
 Empirical equations
 Infiltration and surface runoff
 Actual evapotranspiration
 Percolation and capillary rise
 Groundwater flow

CE 520 PHYSICAL HYDROLOGY**COURSE OUTLINE**

TOPIC

Linear System Theory and Rainfall-Runoff Analysis

- Unit hydrograph theory
- Instantaneous unit hydrograph (IUH)
- Linear reservoir
- Nash model

Geomorphology and Basin Response

- Basin structure.
- Channel network structure.
- Geomorphology, climate and hydrologic response:
 - GIUH
 - GCIUH

Snowpack and Snowmelt

- Snowpack
 - Density
 - Cold content
 - Thermal quality
 - Liquid-water content
 - Albedo
- Energy budget and snowmelt
- Air temperature and snowmelt
- Snowmelt routing through snowpack
- Snowmelt runoff modeling:
 - Lumped models
 - Distributed Models
 - Energy balance-based models
 - Temperature index-based models
 - Physiographic and climatic controls

Advanced Topics

- Global hydrology and climate change.
- Regional hydrology and climate change.