

## CIVE 520 PHYSICAL HYDROLOGY

### INSTRUCTOR

JORGE A. RAMÍREZ

Professor

Civil and Environmental Engineering Department

A222 Engineering Building

Phone: 491-7621

Office Hours: MWF 10:00 - 11:00 AM - A222 Engineering Building

### CLASS SCHEDULE

Lecture: MWF - 9:00 - 9:50 AM – Room B-2 Engineering Building

### REFERENCES

1. *Hydrology, An Introduction* by Wilfried Brutsaert. Cambridge University Press, 2005.
2. *Hydrology, an Introduction to Hydrologic Science* by R. L. Bras. Addison Wesley, 1990.
3. *Dynamic Hydrology* by Peter S. Eagleson. McGraw Hill, 1970.
4. *Physical Hydrology* by L. S. Dingman. Upper Saddle River, N.J.: Prentice Hall, 1994.
5. *Applied Hydrology* by V. T. Chow, D. Maidment, and L. W. Mays. McGraw Hill, 1988.
6. *Atmospheric Science, an Introductory Survey* by J. Wallace and P. Hobbs. Academic Press, 1977.
7. *Physical Climatology* by W. D. Sellers. The University of Chicago Press, 1974.
8. *Hydraulics of Groundwater* by J. Bear. McGraw Hill, 1979.
9. *Introduction to Hydrology* by W. Viessman, J. Knapp, G. Lewis, T. Harbaugh. Crowell, Harper and Row, 1977.
10. *Hydrology for Engineers* by R. Linsley, M. Kohler, and J. Paulhus. McGraw Hill, 1975.
11. 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.

### ACADEMIC INTEGRITY AND HONOR PLEDGE

This course will adhere to the Academic Integrity Policy of the Colorado State University General Catalog and the Student Conduct Code. Accordingly, we will use an honor pledge for all homework assignments and all exams as indicated below.

The honor pledge will be:

*“I pledge that I have not given, received, or used any unauthorized assistance.”*

*“I pledge that I will not give, receive, or use any unauthorized assistance.”*

CIVE 520  
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**COURSE OUTLINE**

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**TOPIC**

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*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 - Runoff*

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

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**COURSE OUTLINE**

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**TOPIC**

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*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.