CIVE 520 PHYSICAL HYDROLOGY

INSTRUCTOR
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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
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:
“\textit{I pledge that I have not given, received, or used any unauthorized assistance.}”
“\textit{I pledge that I will not give, receive, or use any unauthorized assistance.}”
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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 - Runoff
Flow in unsaturated porous media
Infiltration and exfiltration
Empirical equations
Infiltration and surface runoff
Actual evapotranspiration
Percolation and capillary rise
Groundwater flow
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.