Course Name:
Advanced Hydrology

Course Number:
20664

Credit:
3

Course Content (outline):

- Overview of Basic Concepts in River Basin Hydrology
  - Hydrologic cycle
  - Hydrologic processes
  - Runoff generation processes
  - Water and energy balance in hydrologic systems

- River Basin Hydro-Geomorphologic Characteristics
  - Principles of channel network initiation
  - Ordering of channel network
  - Horton laws
  - Physiographic attributes of a river basin
  - Scaling relationships between geometric and topographic attributes of a river basin
  - Stream channel hydraulic-geometry relationships
  - The width function

- Fractal Characteristics of River Basins
  - Fractals and fractal dimensions
  - The box counting dimension
  - Self-similarity in river basins
  - Tests of self-similarity
  - Self-affinity in river basins
  - Hack’s law

- Wavelet Transform and its Application in Analyzing Hydrologic and Topographic Datasets
  - Overview of Fourier transform and spectrum
  - The wavelet transform
  - Continuous wavelet transform
  - Contentious models of wavelet functions
  - Wavelet-based energy and power spectra
  - Edge detection and feature extraction
  - Discrete wavelet transform
  - The Haar and Daubechies wavelets
  - Redundancy in wavelet transform and synthesis
  - Spectral properties of river basin topography
- Travel-Time Based Modeling of Transport in Hydrological Systems
  - Lumped hydrologic modeling: opportunities and challenges
  - Overview of unit hydrograph theory and assumptions
  - Residence versus travel time of water
  - A brief overview of tracer and isotope hydrology
  - Theory of time-variant travel time distribution
  - Storage selection function and its estimation methods
  - Stochastic soil-moisture models of transport
  - Modeling river hydrochemistry using dynamic travel time distribution

- Distributed Hydrologic Modeling
  - Flow components
  - Mechanisms of runoff generation
  - Continuum consideration
  - Potential and head
  - Darcy’s equation
  - Richards' equation
  - Moisture-release equations
  - Interaction between surface and subsurface flows
  - Principles of Land Surface Models (LSMs)
  - Energy balance at the land surface
  - Modeling latent and sensible heats in hydrologic systems
  - Snowmelt modeling

- Evaluation and Calibration of Hydrologic Models
  - Calibration vs. validation
  - Parameter estimation and uncertainly
  - Sensitivity analysis
  - Overview of statistical approaches for evaluation of hydrologic models

References: