Course Description:

This course provides an introduction to the principles, methods, and applications of modeling hydrological processes and coastal dynamics. Students will learn how to simulate surface water flows, sediment transport, water quality, and coastal circulation using widely used modeling tools. Emphasis will be placed on model setup, calibration, validation, and the interpretation of simulation results for research and management purposes.

Course Objectives:

By the end of the course, students will be able to:

- Understand key hydrological and coastal processes that can be modeled.
- Set up, run, and analyze hydrodynamic and watershed models.
- Apply models to address environmental challenges like flooding, sedimentation, and coastal erosion.
- Interpret model outputs critically for real-world decision-making.
- Recognize limitations, uncertainties, and ethical considerations in modeling.

Prerequisites:

Background in fluid mechanics, basic hydrology, and environmental science; some programming experience (e.g., Python, MATLAB) is beneficial.

Textbooks and References:

- *Hydrodynamics and Water Quality: Modeling Rivers, Lakes, and Estuaries* by Zhen-Gang Ji (recommended)
- *Coastal Hydrodynamics and Sediment Dynamics* by A. Osborne M. Phillips (optional)
- Selected journal articles and model manuals (provided weekly)

Software and Tools:

- HEC-HMS and HEC-RAS (Hydrologic and Hydraulic Engineering Center models)
- EFDC (Environmental Fluid Dynamics Code)
- Delft3D
- SWAN (Simulating Waves Nearshore)
- Python, MATLAB, or R for data processing and visualization
- ArcGIS or QGIS for spatial analysis

Weekly Topics:

Week	Topics
1	Introduction to Hydrological and Coastal Systems
2	Watershed Hydrology and Runoff Generation
3	Basics of River Hydrodynamics
4	Sediment Transport in Rivers
5	Coastal Processes: Waves, Tides, Currents
6	Numerical Modeling Principles: Grids, Solvers, Stability
7	Watershed Modeling with HEC-HMS
8	River and Floodplain Modeling with HEC-RAS
9	Estuarine and Coastal Circulation Modeling (EFDC/Delft3D)
10	Sediment Dynamics and Morphological Changes
11	Coupling Hydrological and Coastal Models
12	Calibration, Validation, and Sensitivity Analysis
13	Case Studies: Flood Risk Management and Coastal Restoration
14	Final Project Presentations and Course Wrap-up

Assessment:

- Homework Assignments and Lab Exercises (30%)
- Midterm Exam (20%)
- Final Project (30%)
- Participation and Presentations (10%)
- Short Quizzes (10%)

Final Project:

Each student or group will complete a modeling project such as:

- Simulating river discharge and flood inundation.
- Modeling coastal erosion under storm scenarios.
- Predicting sediment deposition in a delta.
- Analyzing water quality dynamics in estuarine systems.

Course Policies:

- Attendance is highly encouraged for hands-on lab sessions.
- Projects must reflect individual effort with appropriate citations.
- Academic honesty is strictly enforced.

Important Dates:

- Midterm Exam: Week 8
- Final Project Proposal Due: Week 10

- Final Project Submission: Week 14