ENVE 4810 ENGINEERING HYDROLOGY, Fall 2022

University of Connecticut
Department of Civil & Environmental Engineering

Brief Description:	Hydrologic cycle: precipitation, interception, depression storage, infiltration, evaportranspiration, overland flow, snow hydrology, groundwater and streamflow processes. Stream hydrographs and flood routing. Hydrologic modeling and design. Computer applications. Design project.
Prerequisites:	ENVE 3120 or equivalent
Lecture Time/Place	MWF 9:05-9:55am, AUST 344
Lab&Field Time/Place	Labs 1 & 2: CAST 114 & front lawn Field trip: Merrow Meadow Station on the Willimantic River
Exam Time/Place	Exam 1 (10/7); Exam 2 (11/11); Exam 3 (12/9), AUST 344
Instructor	Dr. Guiling Wang http://www.hydroclimatology.uconn.edu/ Phone: (860) 486-5648 Email: guiling.wang@uconn.edu Webex: https://uconn-cmr.webex.com/meet/guw02001
Teaching Assistant	Mr. Koushan Mohammadi Email: koushan.mohammadi@uconn.edu Webex: https://uconn-cmr.webex.com/meet/kom19001
Reference Books	"Applied Hydrology" by Chow, Maidment, and Mays, from McGraw Hill (selected chapters posted in huskyCT) "Introduction to Hydrology" (eBook by Steve Margulis; pdf file posted in HuskyCT)
Office Hours	Guiling Wang: Friday, 11am-12 (Castleman 315, in person); additional hours by appointment Koushan Mohammadi: Monday, 11am-12 (Cast 205, in person) Wednesday, 11am-12 (webex)
Communications	**Instructor/TA to students**: HuskyCT (announcements, weekly reminders, surveys, assignments, course materials, etc) **Students to instructor/TA**: Emails, in-person meetings

Inclusion Statement:
Professor Wang is a member of the INCLUDE program team, a NSF-funded neurodiversity initiative that aspires to create an inclusive learning environment in which *all* students can thrive. Emphasis is given to providing a strengths-based approach to education that encourages students to identify, develop, and leverage their unique abilities to address complex engineering problems. This course was designed to address the diverse thinking and learning styles that neurodiverse students possess. Several pedagogical innovations will be implemented in this course including, but not limited to accessible captioned video on key concepts, peer-peer interactions, active learning, alternative examination modalities, oral makeup exam, project-based learning, etc.

Accessibility Statement:

The University of Connecticut is committed to protecting the rights of individuals with disabilities and assuring that the learning environment is accessible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. Students who require accommodations should contact the Center for Students with Disabilities, Wilbur Cross Building Room 204, (860) 486-2020 or http://csd.uconn.edu/.

Software/Technical Requirements (with Accessibility & Privacy Information):

The software/technical requirements for this course include:

- HuskyCT/Blackboard (HuskyCT/ Blackboard Accessibility Statement, HuskyCT/ Blackboard Privacy Policy)
- ***iClickers*** (https://join.iclicker.com/1VPWK)
- CATME (https://www.catme.org/login/index)
- Excel or other programing languages (e.g., Matlab, Python) for data analysis
- Adobe Acrobat Reader (Accessibility Statement, Privacy Policy)
- Google Apps (Google Apps Accessibility, Google for Education Privacy Policy)
- Microsoft Office (free to UConn students through uconn.onthehub.com) (Microsoft Accessibility Statement, Microsoft Privacy Statement)
- High-speed internet with a minimum speed of 1.5 Mbps (4 Mbps or higher is recommended)

University students are expected to demonstrate competency in Computer Technology. Explore the Computer Technology Competencies page for more information.

For information on managing your privacy at the University of Connecticut, visit the University's Privacy page.

Course Evaluation:

Students will be provided an opportunity to evaluate instruction in this course using the University's standard procedures, administered by the Office of Institutional Research and Effectiveness (OIRE). Additional informal formative surveys will be administered within the course as an optional evaluation tool and as a feedback mechanism to the instructor.

Academic Integrity:

Students will be held to the standards laid out in *The Student Code:* http://community.uconn.edu/the-student-code-preamble/

Course Objectives/Outcomes and Assessment Plan:

1) To gain a broad understanding of the main scientific theories and principles governing processes in the hydrologic cycle (precipitation, infiltration, runoff, evapotranspiration etc.)
2) To develop quantitative skills for characterizing major hydrologic components
3) To apply key concepts to several practical areas of engineering hydrology (e.g., flood forecast) and related design aspects (e.g., design flood or design storm).

Understanding will be assessed through in-class active learning activities using iClicker, end-of-chapter online quizzes focused on concepts, and short answer questions in exams;

Quantitative skills will be assessed through calculation-based homework assignments and exam questions to be solved using methodologies and equations taught in class;

Ability to apply course materials in solving practical engineering problem will be assessed through class project and relevant questions in exams (e.g., on flood routing and forecast; design storm analysis)

Specific Learning Objectives:

1) Understand the concept of the hydrological cycle, identify and quantify the main elements of the hydrological cycle (Modules 1-8)
2) Understand the mechanisms for precipitation generation and the concept of atmospheric stability, estimate precipitation intensity, and quantify its response to changes in environmental factors (Module 2)
3) Identify the main factors controlling evaporation, and estimate evaporation rate using different approaches (Module 3)
4) Understand and quantify unsaturated flow in porous media, and estimate cumulative infiltration and infiltration rate using different methods (Module 4)
5) Understand the different runoff generating mechanisms, perform base flow separation using different techniques, and quantify the relationship between excess rainfall, overland flow, and channel flow (Module 5)
6) Solve flow depth, velocity, or flow rate for overland flow and channel flow (Module 5)
7) Conduct frequency/return period analysis for extreme events and design storms (Module 6)
8) Perform unit hydrograph analysis and lumped flow prediction for gauged and ungauged watersheds (Module 7)
9) Understand the concept of hydrological routing, and know how to perform river routing and reservoir routing using at least one approach (Module 8)

Course Format: This course is primarily lecture-based, with two lab experiments and one field trip that take place during the scheduled lecture time. The in-person lectures will be captured and posted in HuskyCT for those interested in reviewing. This will be supplemented by short online video lectures (with caption) on selected concepts that are critical or especially challenging. Lecture slides for each module will be posted in HuskyCT before class (and will be updated at the end of each module); problems solved in class will be posted no later than the end of each module (but not before class).

HuskyCT and Weekly Announcements:

All homework, online quizzes, labs, project, and surveys will be assigned (and submitted) through HuskyCT.
Weekly reminders will be sent out in HuskyCT that outline the planned learning activities and deadlines for the upcoming week. Please note that occasionally deadlines may be revised and such changes will be announced through HuskyCT. Please refer to the course's HuskyCT webpage for detailed information.

Course Grading

Course Elements	**Weight**
Homework Assignments	15%
Online Quizzes	5%
Term Project	10%
Labs (2) + Field Trip	5% (2% + 2% + 1%)
Class Participation	5% (iClicker response; survey participation; mock exams; discussion/Q&A)
Midterm Exams (3)	60% (each 20%)
Final Exam (optional)	0 (waived) or 20% (taken to replace 1st or 2nd Midterm)

Overall Grade Scale

A	= 93 – 100%	**B**	= 83 –86%	**C**	= 73 – 76%	**D**	= 63 – 66%
A-	= 90 – 92%	**B-**	= 80 – 82%	**C-**	= 70 – 72%	**D-**	= 60– 62%
B+	= 87 – 89%	**C+**	= 77 –79%	**D+**	= 67 – 69%	**F**	= 0 – 59%

Note: This grade scale is guaranteed. The instructor reserves the right to bump students up to the next-higher grade when deemed appropriate (as determined by the instructor).

Homework: Homework assignments should be turned in by the assigned due date, and will be graded primarily based on effort. Discussion or collaboration is allowed and encouraged as that can help the learning process. However, any evidence of direct copying will result in a zero homework grade for all parties involved. Copying from solution manuals will also result in a zero homework grade.

Exams: There will be three required mid-term exams and an optional final exam; each exam will be one-hour long. These are open-book in-class exams, but students are required write two-page formulae sheet for easy reference. All exams are in person.

- **Midterm 1:** Water cycle, precipitation, evapotranspiration (Modules 1-3)
- **Midterm 2:** Infiltration, runoff (Modules 4-5)
- **Midterm 3 (Last week of class or final exam week):** River flow and unit hydrograph, routing, hydrological extremes (Modules 6-8)
- **Final Exam:** Reserved for those who wish to improve their score for either Midterm 1 or Midterm 2 (not both), and the score will replace the chosen midterm score. This will be a 1-hour exam during the official finale exam time (immediately following Midterm 3 if Midterm 3 is scheduled during the final exam week).

Alternative strength-based evaluation format: Instead of taking the written exam, students are given the option to take a 30-minute oral exam with the instructor and the TA (schedule to be coordinated). In addition, for those who score less than 60% of the points in any mid-term exam, they can choose to take an oral makeup exam (typically held in the week after the written exam and based on schedule coordination with the instructor and TA); makeup exam scores will be capped to 75% of the full score.

Online Quizzes: Online quizzes will be given towards the end of each module; available time and deadlines will be announced in HuskyCT. Students will be given one week (and unlimited repeats) to complete the quizzes. *(Note: The quiz link will not be visible and cannot be started after the deadline)*

Lab/Field Experiments: Including two labs and one field trip, focused on measurement and analysis of hydrologic processes. Students will work on the two labs as teams (3-4 member in each group). For each lab, two sessions will be scheduled (signing up sheet to be posted)
Lab 1: measurement of precipitation using rain gauges
Lab 2: infiltration experiment using infiltrometers

A field trip to the Willimantic river gauge at the Merrow Meadow station and demonstration of streamflow measurement techniques will be coordinated with USGS technicians. The specific date will depend on the USGS personnel's schedule. More details will be announced in HuskyCT.

Design Project with strength-based modalities: A team-based term project will be assigned to encourage peer-to-peer interactions; however, students will be allowed to conduct the project individually if so preferred. Students have the options to submit a final written report or give an oral presentation to the instructor and TA.

Teamwork and evaluation: Students are encouraged to interact and collaborate with their peers. Several course activities will contribute to help students develop teamwork skills (lab experiments and reports, field trip report, design project). Teams will be formed on a voluntary basis, and for some teams this may be dictated by common availability during two lab sessions that have to be scheduled out of regular class time.

Grading of team work considers individuals' contribution as reflected through peer evaluation facilitated by CATME (https://www.catme.org/login/index). All members of the team must complete a peer evaluation survey (by specified deadline) in order to receive a grade for each team assignment; individuals evaluated poorly by peers will receive a lower score than the rest of the team. Exceptions may be considered under extenuating circumstances and have to be discussed with the instructor/TA.

Active learning: Multiple strategies will be utilized to facilitate active learning, including (but not limited to) "pair and share" and in-class quizzes/surveys facilitated through ***iClickers*** (https://join.iclicker.com/1VPWK)

Contribution to class ("*Thinking like a professor*"): Students are expected to actively participate in and contribute to course activities (whether in or outside the classroom). Beyond active learning activities in class, all students are invited to form teams to discuss and put together mock exam questions. This contributes to student participation grade and original well-thought contributions will be awarded with bonus point(s). The teams here do not have to be the same as the team formed for lab/project purposes; to provide flexibility, students can also write mock exams individually.

Communication

Student to Instructor and TA	Email, in person during Office Hours, WebEx
Instructor to Students	HuskyCT announcement, Email

Resources for Students Experiencing Distress

The University of Connecticut is committed to supporting students in their mental health, their psychological and social well-being, and their connection to their academic experience and overall wellness. The university believes that academic, personal, and professional development can flourish only when each member of our community is assured equitable access to mental health services. The university aims to make access to mental health attainable while fostering a community reflecting equity and diversity and understands that good mental health may lead to personal and professional growth, greater self-awareness, increased social engagement, enhanced academic success, and campus and community involvement.
Students who feel they may benefit from speaking with a mental health professional can find support and resources through the Student Health and Wellness-Mental Health (SHaW-MH) office. Through SHaW-MH, students can make an appointment.

General Course Outline

(Chapter numbers pertain to the Chow et al. book "Applied Hydrology")

Module 1: Introduction and Hydrologic Cycle (chapter 1)
- 1a: Introduction to hydrological cycle: the concept
- 1b: Mass balance: concept and equation
- 1c: Hydrological Model Classification

Module 2: Precipitation (chapters 3 and 6)
- 2a: Moisture in the atmosphere
- 2b: Precipitation generation mechanisms
- 2b: Atmospheric profile and stability
- 2c: Precipitation characteristics and quantification

Module 3: Evapotranspiration (chapter 3 and 6)
- 3a: Surface radiation budget
- 3b: Evaporation: Potential/reference/actual
- 3c: Quantifying evaporation

---------- Midterm Exam 1 ----------

Module 4: Infiltration (chapter 4 and 6)
- 4a: Soil hydraulic properties and unsaturated flow concept
- 4b: Potential infiltration and actual infiltration
- 4c: Quantifying infiltration under contsant rain rate
- 4d: quantifying infiltration under varying rain rate

Module 5: Runoff (chapters 5 and 6)
- 5a: Runoff generation mechanisms
- 5b: Base flow separation techniques
- 5c: Excess rain-direct runoff relationship
- 5d: Rating curve (flow depth and flow rate calculation)

---------- Midterm Exam 2 ----------

Module 6: Unit hydrograph and Streamflow Forecast (Chapter 7)
- 6a: Streamflow hydrograph and unit hydrograph
- 6b: Streamflow forecast in gauged watershed
- 6c: Streamflow forecast in ungauged watershed

Module 7: Extreme Analysis & Design Storm/Flood (Chapters 11-15)
- 8a: Hydrological extreme and frequency analysis
- 8b: Design storm/design flood

Module 8: Hydrologic Routing (Chapters 8-10)
- 7a: Routing fundamentals
- 7b: River routing
- 7c: Reservoir routing

---------- Midterm Exam 3 / Final Exam ----------

ENVE 4810: Tentative Course Schedule / Calendar			
Week	**Dates**	**Topic**	**Chapter**
1	Aug 29-Sept2	Mod 1: Introduction / Water Cycle ***Survey 1: initial self-reflection***	Chapter 1
2	Sept 6-9	Mod 2: Atmospheric Water and Precipitation: Part 1	Chapter 3
3	Sept 12-16	Mod 2: Atmospheric Water and Precipitation: Part 2 ***LAB 1: Rain Gauge Calibration & Measurement (Cast 114)***	Chapters 3, 6
4	Sept 19-23	Mod 3: Surface Energy Budget and Evaporation	Chapters 3
5	Sept 26-30	Mod 3: Evaporation ***Friday Review***	Chapters 3, 6
6	Oct 3-7	Mod 4: Infiltration **EXAM 1 (Chapters 1, 3, 6) Friday Oct.7** ***Survey 2: Formative assessment and reflection***	Chapter 4
7	Oct 10-14	Mod 4: Infiltration (continued)	Chapter 4
8	Oct 17-21	Mod 4: Infiltration (continued) **LAB 2 Infiltrometer (CAST 114 & lawn) Wednesday** **Field Trip to Merrow Meadow Station Friday**	Chapter 5
9	Oct 24-28	Mod 5: Surface Water	Chapter 5, 6
10	Oct 31-Nov 4	***Reviews for Midterm 2*** Mod 6: Unit Hydrograph, Streamflow Measurement and Forecast Term Project Assigned	Chapter 7
11	Nov 7-11	Mod 6: Unit Hydrograph, Streamflow Measurement and Forecast (continued) **EXAM 2 (Chapters 4, 5, 8) Friday Nov.4**	Chapter 7
12	Nov 14-18	Mod 6 (continued) Mod 7: Hydrological Extremes and Design Storms	Chapter 7, 12
	Nov 21-26	**Thanksgiving Recess**	
13	Nov 28-Dec 2	Mod 8: Hydrological Routing (River routing and reservoir routing)	Chapter 8, 9, 10
14	Dec 5-9	Reviews **EXAM 3 (Chapters 4, 5, 8) Friday Dec.9** **Term Project Due Wednesday Dec. 7**	
Final Exams	Dec 12-18	**Final Exam (Dec. 17, optional – re-take one midterm)** ***Survey 3: Assessment and reflection***	