Course Goals and Objectives

Course Goals: The general goals of this course are to (1) create a broad academic foundation in engineering hydrology that prepares you for continuing education, leading to greater professional competency, and (2) provide you with the fundamental knowledge and tools necessary to perform hydrologic design of drainage systems for professional practice.

Objectives and Outcomes: After completing this course, you will be able to complete the following tasks, among others:
1. Interpret design constraints, determine design data, consider alternative designs, justify design choices, and critique designs for general watershed-scale hydrologic engineering. This overall goal objective encompasses the following outcomes, among others:
2. Describe and measure the components of the hydrologic cycle.
3. Define and delineate watersheds and aquifers and determine hydrologically-relevant characteristics.
4. Describe and compute design storms, evapotranspiration, infiltration, peak discharge, and runoff hydrographs.
5. Perform basic channel and reservoir routing.

General Instruction Information

Classroom/Day: WEB L126, 10:45 – 11:45 am, MWF

Instructor: Brian J. McPherson  
Department of Civil and Environmental Engineering  
Office CME 100  
e-mail: b.j.mcpherson@utah.edu; phone: 581-6931  
Office Hours: 12:00 pm – 1:00 pm Mondays and Wednesdays in CME 100

Teaching Assistant: TBA  
Office hours and location: Times/Days/Location TBA

Course Resources:

Course Website: This class will utilize the Canvas course system accessible at https://utah.instructure.com

Textbook: Bedient, Huber, and Vieux, Hydrology and Floodplain Analysis, Fifth Edition; Electronic Version is encouraged due to its lower price – see http://goo.gl/XKG2kI.
**Laptop:** Each student is required to bring a laptop to every class period. Your laptop must be ready to connect to the internet during every class period.

**Software:** Each student is required to have HEC-HMS downloaded on their personal computer brought to class. This can be downloaded for free from [http://www.hec.usace.army.mil/software/hec-hms/downloads.aspx](http://www.hec.usace.army.mil/software/hec-hms/downloads.aspx). Be sure to download at least version 4.0, and install ASAP.

**Course Components and General Policies:**

*Post-Class Lecture Videos / Webcasts*

Prof. McPherson will lecture (live) every class period. However, for many class periods, the course will offer short recorded lecture videos posted online, posted under the “Pages - Lecture Materials” link of the course Canvas portal. These are intended to complement what’s discussed in class live. Questions and discussion are absolutely encouraged.

*Attendance*

You are expected to attend class and to arrive on time. Material may be presented in class that is not included in the reading assignments, or in the posted webcasts. You shall be required to know this material for homework and exams.

*Reading Assignments:*

Reading assignments will be posted on the course website (“Pages - Reading Assignments” link in the course Canvas portal). You are expected to read assigned pages as soon as possible; please monitor the portal for these assignments.

*Homework:*

Homework problems will be assigned on a regular basis, under the “Assignments” link in the course Canvas portal. Due dates will be specified, and solutions will be posted after the due date of each assignment.

*Term Project:*

You will be assigned a specific site on campus to base a hydrologic engineering design, and you will spend the rest of the semester characterizing the hydrologic (engineering) aspects of that site, using concepts and methods discussed in class. By the end of the semester, you will build and use a systems-analysis computer model of your assigned site and the watershed area that directly affects your site. Ultimately, you will use your model to assess how much runoff is associated with your assigned site. Although our campus is connected to a storm sewer system, you will also be required to design a detention basin to contain that runoff (e.g., representing a scenario if the storm drains were not in place). As much as possible, your homework assignments will utilize example problems focused on your assigned site. Additionally, other hydrologic assessments (associated with campus) will be assigned during the course of the semester, as topics are covered in class, to facilitate completion of portions of your term project. Thus, consider the term project a “work in progress” for the duration of the semester.
The final product of your term project will be a comprehensive report that summarizes your assessments, including results of ancillary homework and other assigned activities. Individual sections or chapters of the term project report will be due during the course of the semester. The general scope of the term project, as well as due dates, etc. will be posted under the “Pages – Term Project” section of the course Canvas portal.

**Final Project Video:**
As a means of emphasizing technical communication beyond written reporting, in addition to the written report, all students will be required to either:

(a) produce a video (mp4 file or equivalent) that summarizes your term project, or
(b) present a live talk that summarizes your term project.

For either option, the presentation or webcast must be no shorter than 5 minutes and no longer than 10 minutes. More details will be provided with the term project assignment during the semester.

**Exams:**
The course includes two “midterm” exams, and a Final Exam. Each will be “comprehensive,” with emphasis on the material covered since the previous exam. The exams are intended to test your mastery of the stated learning objectives presented in classes before the exam date. Exams may include both closed and open book sections.

**Grading Policy:** The final grade will be based on a weighted-average of your homework assignment results, the term project, quizzes and exams. The weighting will be as follows:

- **Homework:** 20%
- **Midterm Exam 1:** 20%
- **Midterm Exam 2:** 20%
- **Final Exam:** 20%
- **Term Project:** 20%

The tentative final letter grade scale is as follows (scale may be adjusted as necessary based on the final average for all students in the course):

- 90 – 100: A
- 80 – 90: B
- 70 – 80: C
- 60 – 70: D
- < 60: E

*At the end of the semester the +/- cutoffs will be chosen based on visible breaks in the final averages.*

**Course Schedule of Topics** (subject to change): Posted under the “Pages - Course Schedule” link on the course Canvas portal. The list of major topics and tentative order of presentation includes:

1. Intro: the Hydrologic Cycle, watersheds, hydrographs, hyetographs
2. Precipitation Mechanisms and Rainfall Averaging Methods
3. Frequency Analysis 1
4. Frequency Analysis 2
5. Frequency Analysis 3
6. Frequency Analysis 4
7. Frequency Analysis 5
8. Frequency Analysis 6
9. Design Storms
10. HEC-HMS Session: Intro
11. HEC-HMS and Term Project Initiation Session: Design Storms
12. Abstractions and Mass Balance
13. Abstractions: ET (Penman Approach)
14. Midterm 1
15. Abstractions: Infiltration (general)
17. Abstractions: Infiltration – Green Ampt Method
18. Watersheds and Watershed Delineation
19. Watershed Characteristics, Runoff/Discharge, Peak Discharge (rational method)
20. HEC-HMS/Term Project Session: Watersheds, Basins and Sub-basins
21. Hydrographs –hydrograph anatomy, baseflow separation
22. HEC-HMS/Term Project Session: Presenting and Discussing Hydrographs
23. Unit Hydrographs
24. Unit Hydrograph Convolution
25. Curve Number Hydrology
26. HEC-HMS/Term Project Session: SCS Unit Hydrograph and Curve Number Assignment
27. Tabular Hydrograph Method
28. Time of Concentration
29. Midterm 2
30. HEC-HMS/Term Project Session: Time of Concentration and Lag Time
31. Cowan’s Method for Time of Concentration
32. Channel Routing
33. Reservoir Routing (Modified Puls) 1 - Calibration
34. Reservoir Routing 2
35. HEC-HMS/Term Project Session: Stage-Storage-Discharge
36. Detention Basin Design
37. HEC-HMS/Term Project Session: Detention Basins and Outlet Structures
38. Drainage Design and Allowable Spread
39. Inlet Sizing
40. Pipe Sizing
41. Review for Final Exam

Other/Miscellaneous:

Computer Usage: Homework assignments and the term projects will require extensive use of hydrologic modeling software, spreadsheets, graphics, word processing, and data analysis software.

Oral/Written Communications: Student input is solicited during classroom presentations and discussions; the format of the course encourages interactive participation, and discourages passive participation. The term project entails a thorough engineering report.

Design Activities: Students are introduced to the principles of analysis and design of surface water drainage systems. These topics are reinforced through the homework exercises and the term
Statistics and Probability: Basic statistical methods are used to perform hydrologic frequency analysis.

Social, Safety, and Economic Issues: Economic issues are considered during discussions of system design and analysis and may be incorporated into the term project. Safety and social issues are discussed during course content related to drainage design and flood control.

Note: the online version of the syllabus posted on the course Canvas portal supersedes any printed version.
Course Contribution to ABET Program Outcomes:

a. An ability to apply knowledge of mathematics (including differential equations), probability and statistics, and science (to include calculus-based physics and general chemistry) to engineering problems.

Physics-based models are used throughout the course. Concepts covered in the statistics pre-requisite are reinforced through problem solving during the frequency analysis content. Integration is required for derivation of fundamental equations and problem solving throughout the course. This outcome is assessed using the comprehensive final exam.

a. An ability to design and conduct experiments, as well as to critically analyze and interpret data, in more than one of the recognized major civil engineering areas, such as structures, transportation, water resources, and environmental.

This course does not include a laboratory component. Slight exposure to data analysis will come in the form of example problems, homework solutions, quizzes, and exams. This outcome is assessed using assigned engineering problems, required student presentations of concepts and assigned problems, and exams from selected students.

a. An ability to design a sustainable and constructible civil engineering system, component, or process to meet desired needs, and that considers life-cycle-cost issues.

A majority of the course focuses on application to design of stormwater drainage systems. The content culminates in a term-based project that requires the students to complete a design or analysis of a drainage system and if appropriate determine the life-cycle costs of the design. Each student is required to prepare a report and presentation, both of which are critiqued by their peers in private reviews and ratings. Summary of feedback from the instructor is provided to each student at the completion of the project requirements.

a. An ability to function on multi-disciplinary teams.

Albeit term projects will be completed individually, extensive collaborative work will be required to optimize the term project design and report. This outcome is assessed using a student survey at the completion of the term project.

a. An ability to identify, formulate, and solve civil engineering problems in at least four of the following areas: structural, geotechnical, transportation, environmental, and water resources.

Example problems, homework assignments, and term project require students to establish understanding of problem, formulate methodology, and complete solution in the water resources focus area. This outcome is assessed using the comprehensive final exam.

a. An understanding of civil, professional, and ethical responsibility, especially as it relates to health and safety, and the importance of professional licensure.

Students are required to act in a professional and ethical manner during all class activities. The importance of professional licensure is stressed during design discussions.
a. An ability to communicate effectively using written, graphical, and verbal skills.

Students must prepare a report for the term project that is graded based on writing quality. Students are also responsible for preparing a comprehensive professional presentation and delivering the presentation to their peers. Term project reports and presentations are reviewed to assess this outcome.

a. The broad education necessary to understand the ethical, economic, environmental, social, and political impact of engineering solutions in a global and societal context.

Students are introduced to the ubiquitous nature of hydrology in everyday life. The impacts of the planning and design of the hydrologic systems on the environment and society is described when appropriate.

a. A recognition of the need for, and an ability to engage in life-long learning and continuing engineering education as a necessary part of professional practice.

Frequently at terminal points for content in the course the potential applications of the topic in the engineering field are described and the need for continued education on the topic is stressed.

a. A knowledge of contemporary issues that are affecting our infrastructure and environment.

Examples of basic principles and discussions of design process include contemporary issues.

a. An understanding of and ability to use the techniques, skills to include engineering economics skills, and modern engineering tools necessary for professional practice.

Students are introduced to current numerical models of hydrologic systems and drilled with several assignments on the use of computer models. This outcome is assessed during the term project. Students are expected to have the abilities to perform a design project using engineering tools learned in class or learned through external study. Randomly selected term project reports are saved to document abilities and identify areas for improvement. These are stressed in the term project assignments the following semester.