# ENE421: Engineering Hydrology

Fall 2016

**Instructor:** Prof. P. Mantha, Department of Civil & Environmental Engineering, 1449 Engineering Research Court Room A130, Michigan State University, East Lansing, MI 48824.
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**Class Meets:** M, W, F 1:50 pm – 2:40 pm, Room: 1260 Anthony Hall.

**Regular Office Hours:** M, W: 4:00 – 5:00 PM (Room: TBD) or by appointment

**Text:** Larry W. Mays, ***Water Resources Engineering***, Second Edition, John Wiley & Sons Inc.
ISBN: 978-0-470-46064-1. To purchase the textbook directly from the publisher for $83.20 (custom edition for MSU students), please use the following link: http://store.vitalsource.com/show/9781119316930

**Course Objectives:**

1. Compute infiltration in soils (E)
2. Apply the principles of sustainability in design (S)
3. Apply Darcy's law to analyze simple 1-D groundwater flows (E)
4. Apply well dynamics theory to predict drawdown in an aquifer (E)
5. Use the unit hydrograph technique to determine a stream flow hydrograph (E)
6. Use the rational method to determine peak flow and develop a synthetic hydrograph (C)
7. Design a sewer system for a planned development (C)
8. Determine the size of detention pond required to control runoff from an urban development. (C)
9. Identify the basic elements of your design that are specifically controlled by federal, state and/or local regulations or codes. (P3)
10. Explain the basic concepts in project management (P1)
11. Explain the basic concepts in leadership (P4)
12. Learn to apply the principles of cost-effective design for contaminant plume management (P2)
13. Recognize the need for and the ability to engage in life-long learning (I)
14. Demonstrate knowledge of contemporary issues (J)
15. Identify and assess the impact of engineering solutions in global, economic, environmental, and societal contexts (H)

**My Teaching Philosophy:** My goal in teaching is to prepare students to become confident and responsible professionals. My approach to teaching involves being a facilitator in the learning process as opposed to being an authoritarian favoring one-way transfer of information. My objectives, therefore, are to understand and respect individual differences in learning and do the best I can to promote learning in the classroom by working with individual differences rather than against them. At the same time, I wish to impart technical skills and a sense of responsibility by encouraging students to play the role of professionals in the classroom. I expect students to put their best effort in this course. This involves participating in the in-class exercises, reading the assigned material before attending class, doing the homework, editing the project reports until they are clear and correct, and preparing for quizzes and exams.

**Academic honesty:** Copying all, or part, of someone else's work, or project report, or looking at someone else's quiz or exam during a test period are all obvious forms of academic dishonesty.

**Anyone found guilty of academic dishonesty will get a 0.0 for the entire course.** For additional information visit the web page of the office of the ombudsman: https://www.msu.edu/unit/ombud/

**Grading Policy:** Your final grade will be based on your performance in the weekly homework assignments, four quizzes, two projects, a final exam and random in-class activities. Details are given below:

- (5%) Random In-class activities based on material being covered in class
- (20%) Homework: Weekly homework, due a week after it is assigned. No late homework is accepted.
- (25%) 2 projects and reports (12% + 13%): Team work (groups of two or three)
- (30%) 4 quizzes (all topics covered after the last quiz; closed book; one cheat sheet allowed).
- (20%) Final exam: comprehensive, closed book; one cheat sheet allowed.

**Grading scale:** I will use the following grading scale:

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| 91 and above | 4.0 |
| Between 85 and 90 | 3.5 |
| Between 85 and 80 | 3.0 |
| Between 80 and 75 | 2.5 |
| Between 75 and 70 | 2.0 |
| Between 70 and 65 | 1.5 |
| Between 65 and 55 | 1.0 |
| Less than 55 | 0.0 |

**Syllabus / Important Dates:** We will try to follow the schedule shown below. If there are errors in the table (or if we decide to cover some topics in more detail during the semester), the dates and topics may change. I will announce these changes in class and/or on the course web page. **It is your responsibility to check the course web page regularly for the latest version of this document.**

**Study groups:** Study groups, if used correctly, can aid your learning. Use a study group to discuss methods that can be employed to solve a homework problem and when and/or why these methods are appropriate. It is inappropriate and academically dishonest to divide-up a homework assignment (problems) among the members of a group, each person doing a few problems and then copying the work of others for problems you did not do.

**Quizzes:** The four quizzes and the final exam will test your understanding of hydrology. There will be an emphasis on the numerical solution of word problems similar to the ones solved in class and assigned for homework. There will also be questions to test the understanding you have developed of basic concepts and principles through your study outside of class. Remember to bring a calculator for all quizzes and the final exam. Closed book. One cheat sheet allowed.

**Use of Electronic Devices in the Classroom: The use of laptops, cell phones, tablets and other similar electronic devices is strictly not allowed during the class hours and during exams.** Anyone found using these devices will be asked to leave the room for that day.

**Homework:** Homework will be assigned to give you some practice using the concepts and procedures discussed in class and in the text. I expect you to do your own homework. Instructions for submitting your

homework will be given when problems are assigned. Due dates will be posted on your course web page and/or announced using the university e-mail system. You are responsible for checking your e-mail and the course web page in a timely manner.

**Course Web Page**: Follow the link: http://www.egr.msu.edu/classes/ce421/mantha/

ENE421: Fall 2016 Schedule

| Topic # | Date | Topic |
|---|---|---|
| | | **Introduction** |
| 1 | Wed, Aug 31, 2016 | Introduction, Course Objectives; The hydrologic cycle (today) |
| 2 | Fri, Sep 2, 2016 | Water: Conservation of mass, water balance; Water at rest and in motion |
| | | **Land-Atmosphere Interactions** |
| | Mon, Sept 5, 2016 | **University Holiday** |
| 3 | Wed, Sept 7, 2016 | Precipitation - 1: Formation and Measurement |
| 4 | Fri, Sept 9, 2016 | Precipitation - 2: Analysis of Precipitation Data (Spatial & Temporal) |
| 5 | Mon, Sept 12, 2016 | Snow, Measurement and Snowmelt |
| 6 | Wed, Sept 14, 2016 | Evapotranspiration (ET) -1 |
| 7 | Fri, Sept 16, 2016 | Evapotranspiration (ET) -2 |
| 8 | Mon, Sept 19, 2016 | Work Problems to Illustrate Theory |
| 9 | Wed, Sept 21, 2016 | **Quiz-1** (Closed book; Topics: #1 - #8) |
| | | **Land-Subsurface Interactions & Groundwater Hydrology** |
| 10 | Fri, Sept 23, 2016 | **Project 1 Out: Form Teams** |
| 11 | Mon, Sept 26, 2016 | Water in Soils and Infiltration |
| 12 | Wed, Sept 28, 2016 | Infiltration Models |
| 13 | Fri, Sept 30, 2016 | Groundwater hydrology: Aquifers |
| 14 | Mon, Oct 3, 2016 | Aquifer Properties and Storage |
| 15 | Wed, Oct 5, 2016 | Theory of Groundwater Flow |
| 16 | Fri, Oct 7, 2016 | Flow nets; Well hydraulics |
| 17 | Mon, Oct 10, 2016 | Unsteady flow: Theis solution; wellfield |
| 18 | Wed, Oct 12, 2016 | Aquifer Test Analyses |
| 19 | Fri, Oct 14, 2016 | Contaminant Transport Modeling |
| 20 | Mon, Oct 17, 2016 | Work Problems to Illustrate Theory |
| | | **Groundwater - Surface Water Interactions & Surface Water Hydrology** |
| 21 | Wed, Oct 19, 2016 | **Quiz-2** (Closed book; Topics: #11 - #20) |
| 22 | Fri, Oct 21, 2016 | Streamflow Measurement |
| 23 | Mon, Oct 24, 2016 | Hillslope Hydrology; Hydrograph separation |
| 24 | Wed, Oct 26, 2016 | Generation of synthetic streamflows |
| 25 | Fri, Oct 28, 2016 | **Project 1 Due; Project 2 Out** |
| 26 | Mon, Oct 31, 2016 | Hydrograph Modeling: The SCS Curve Number method |
| 27 | Wed, Nov 2, 2016 | Hydrograph Modeling: The Unit Hydrograph Technique |
| 28 | Fri, Nov 4, 2016 | Hydrograph Synthesis: Lagging method, S-Curve |
| 29 | Mon, Nov 7, 2016 | Work Problems to Illustrate Theory |
| 30 | Wed, Nov 9, 2016 | **Quiz-3** (Closed book; Topics: #22 - #29) |

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| | | **Principles of Design, Sustainability, Leadership and Management in Water Resources** |
| 31 | Fri, Nov 11, 2016 | Synthetic Hydrographs; Peak flow estimation; time of concentration |
| 32 | Mon, Nov 14, 2016 | Stormwater Sewer Design; Intensity-duration frequency curves |
| 33 | Wed, Nov 16, 2016 | Application of the Rational Method; Design Computations |
| 34 | Fri, Nov 18, 2016 | Streamflow Routing |
| 35 | Mon, Nov 21, 2016 | Computation of Extreme Flows |
| 36 | Wed, Nov 23, 2016 | Storage routing; the PULS method; Reservoir sizing |
| | Fri, Nov 25, 2016 | **University Holiday** |
| 37 | Mon, Nov 28, 2016 | Design of stormwater detention ponds |
| 38 | Wed, Nov 30, 2016 | Work Additional Problems to Illustrate Theory |
| 39 | Fri, Dec 2, 2016 | Additional Concepts of sustainability and regional water balance |
| 40 | Mon, Dec 5, 2016 | **Quiz-4** (Closed book; Topics: #31 - #39) |
| 41 | Wed, Dec 7, 2016 | Principles of cost-effective design; Importance of Professional Licensure |
| 42 | Fri, Dec 9, 2016 | Concepts in Leadership and project management;<br>**Project 2 Due; Classes End** |
| 43 | Mon, Dec 12, 2016 | **Final Exam between 12:45 PM and 2:45 PM in your regular classroom (1260 Anthony Hall). Comprehensive. Closed book.**<br>**Remember to bring a calculator.** |

**In-Class Activities:** The random in-class quizzes will test your understanding of the material being covered in class on any given day. It is not possible to grade all of the in-class quizzes; therefore, a subset of randomly selected quizzes will be graded and the score added to your final grade for the semester. You should, however, assume that all in-class quizzes will be graded.

**Projects.** Projects are an important part of this course. They are carefully selected to give you experience in hydrologic design. Project reports will be evaluated for correctness and completeness. Evaluations are evidence-based so if you claim to have done some calculations, it is important that you include those calculations in your report either as an Appendix or in the main body of the report. Once project teams are formed, I have no way of evaluating individual contributions; therefore I assume that you put in your best effort. From time to time, I talk to project teams to make sure all members have contributed to the final product (the report). If all members of a team indicate that a certain member did not substantially contribute to the project, that individual will receive a zero for the project. Therefore it is your responsibility to work with your project team members and to bring any issues to my attention early on (Please do not wait until the end of the semester or close to a due date to report issues such as, for example, your inability to work in a certain team for any reason).

**Computational Thinking:** I encourage computational thinking in this course as a way of solving problems and thinking about hydrology and hydrologic systems and the world around you in general. What exactly is computational thinking? Do a Google search to learn more or lookup Wikipedia. I encourage the use of software tools such as MATLAB, MATHEMATICA or EXCEL to help you with your day to day computational tasks and for visualizing data. You are doing computations if you are trying to fit a line or a distribution to your data, trying to interpolate scattered rainfall data to create a spatial map of precipitation, or trying to solve a differential equation so you can compare its solution to data that you or someone else collected in the field. I often say that to be a good driver you don't need to understand exactly how the fuel injection system works. In a similar way, you can learn to make intelligent use of readily-available tools such as MATLAB even if you don't understand all the details of the algorithms used inside the functions. I will not be able to teach MATLAB or numerical methods in this course but I expect you to make use of the help system available in MATLAB to learn how to use a function. There are a number of freely available resources on the internet. I am happy to help you with specific tasks but you need to ask!