

**Department of Civil Engineering  
Hydrology and Hydraulic Engineering  
CE 3456  
Tuesdays and Thursdays 10:30 am-11:50 am  
LART 222  
CRN 12697  
Laboratory: T,R,F 1:30--4:20 pm**

**Instructor Contact Information and Biography**

***Dr. Ivonne Santiago***

Engineering Annex A218

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Office: A-218

Office Hours: M 12:00-1:00 PM in office and in virtual office in BB (if requested) or by appointment using

<https://IvonneSantiago.as.me/>

E-mail: [isantiago@utep.edu](mailto:isantiago@utep.edu). **For class matters use Blackboard e-mail under the class communication tools.** I will respond to your emails within 24 business hours..

Phone: 915-747-8478

I grew up in Guayanilla ([http://en.wikipedia.org/wiki/Guayanilla,\\_Puerto\\_Rico](http://en.wikipedia.org/wiki/Guayanilla,_Puerto_Rico)), a municipality of Puerto Rico, located on the southern coast of the island, bordering the Caribbean Sea, south of Adjuntas, east of Yauco; and west of Peñuelas and about 12 miles (20 km) west of Ponce, the 2nd largest city of Puerto



Rico ([http://en.wikipedia.org/wiki/Ponce,\\_Puerto\\_Rico](http://en.wikipedia.org/wiki/Ponce,_Puerto_Rico)) (population <200,000).

I have a Bachelor's degree in Civil Engineering from the University of Puerto Rico at Mayaguez (UPRM), a Master's degree in Environmental Systems Engineering from Clemson University, and a Ph.D. in Civil Engineering, Specialized in Environmental Engineering, from New Mexico State University. In Puerto Rico, I was a professor in Civil Engineering at UPRM and worked in research (EPA, DOD, NSF) dealing with removal of contaminants from water using natural adsorbents, remote telemetry systems for monitoring of a small community drinking water treatment plant, physical modeling of transport of explosive related chemicals in sub-surface environments, and odor problems of combined sewer-overflows. I worked as consultant to the Comptroller of Puerto Rico as an auditor of the 10 largest water and wastewater treatment plants in Puerto Rico. I was part of the Puerto Rico Environmental Quality Board (PREQB) and Director of the Water Quality Area in the PREQB. I was a member of the Environmental Protection Agency National Advisory Committee (NAC). The NAC advises the administrator of the EPA on environmental policy issues related to the implementation of the North American Agreement on Environmental Cooperation. I was also a member of The Good Neighbor Environmental Board (GNEB) that advises the President and Congress of the United States on good neighbor practices along the U.S. border with Mexico. I am currently a Clinical Professor in the Department of Civil Engineering, I am an appointed member of the El Paso Water Public Service Board (PSB), Since I have been at UTEP. I have taught courses in Environmental Engineering, Engineering Economy, Engineering Statics, Water and Wastewater Engineering, Capstone Senior Design Courses (I and II), Thermo-fluids, and Experimental Design. There is not enough space in this syllabus to explain why I left "paradise" for El Paso, but my family ended up here in 2006. I can say I really have come to love UTEP and our students. I have found hard-working students that truly want to build a better future for themselves and their families.

### Course Description

Hydraulics is a broad area with many sub disciplines. This class will focus on fundamental hydraulic principles as illustrated through laboratory experiments. Rather than attempting to cover the entire field, we will focus in detail surface water hydrology, groundwater hydrology, open channel flow, and flow in pipes. Hydraulics is very much a laboratory oriented course and cannot be properly learned in the absence of a laboratory. Laboratory exercises are featured prominently in the class and grading.

Mastery of fundamental concepts will facilitate the student in learning more detailed hydraulics applications throughout his/her career. Although computer codes are frequently used in engineering practice to perform many of the calculations we will cover, the computer codes change with time whereas the fundamental principles upon which the codes are based do not change. The class will focus on fundamentals rather than cook book solutions.

Students are responsible for familiarity with all assigned reading. Quantitative problems on tests will be limited to problems similar to homework problems and problems solved in class. Conceptual and fact questions will be drawn from reading, presentations, and online assignments.

Class format will consist of a combination of brief lectures, presentation of auxiliary materials (e.g., subject matter videos), class exercises, and solution of homework problems. It is assumed that the student has read the textbook chapter and attempted all homework prior to the class period where it is assigned. Unless specifically requested homework does not have to be turned in but may be the subject of quizzes.

#### **Why is this course so Important that it is required for all Civil Engineering Students?**

This course will provide an understanding of fundamental aspects of hydraulic systems, a fundamental task for Civil Engineers. You will need to understand how transport, store, and regulate water on surface and subsurface environments..Can you think of any other reasons why this is such an important course?

#### **What concepts should you know before you start this class?**

From your thermofluids class, you must **already** have an understanding and capacity to analyze/calculate concepts of water forces:

1. Momentum changes on pipes
2. Buoyancy
3. Surface tension/ capillary rise
4. Viscosity and shear stress

### Learning Goals

**The class is divided into four major subject areas. Keep in mind these Learning Goals as you prepare to study for the class exams!**

#### **1. Pipe Flow**

1. Set up the energy equation and solve it for unknown variables (e.g., pipe diameter, flow)
2. Understand fundamentals and determine if a flow is laminar, transitional, or turbulent
3. Estimate major (friction) and minor losses
4. Understand and draw energy and hydraulic grade lines
5. Basic concepts of pump behavior and pump selection

#### **2. Open Channel Flow**

1. Estimate flows using Manning Equation
2. Determine channel dimensions required for design flows
3. Understand and calculate the Froude number and specific energy relationships
4. Understand and predict hydraulic jumps and flow measurements
5. Flow measurement

**3. Surface Water**

1. Hydrologic cycle
2. Methods for estimating peak discharge
3. Return periods and statistics
4. Intensity, Duration, Frequency Curves
5. Design of hydraulic structures.

**4. Ground Water**

1. Darcy's Law
2. Energy relationships in groundwater flow
3. Flow patterns in different groundwater systems
4. Water balance

**Course Resources**

**Required text:** Robert J. Houghtalen, A. Osman Akan and Ned H. C. Hwang, Fundamentals of Hydraulic Engineering Systems (5th Edition) ISBN-13: 978-0-13-429238-0

**Reference text (highly recommended):** Ram S. Gupta. Hydrology and Hydraulic systems (4<sup>th</sup> edition). ISBN-13: 978-1478630913. ISBN-10: 1478630914

**Blackboard:** This is a *Technology Enhanced Course (TEC)*. This means that we will be using Blackboard as the main means of communication, information sharing, on-line quizzes, uploading homeworks, and resource materials. Your homeworks and course material for the week will be posted every Monday by COB, so make sure you make visiting BB part of your weekly routine and schedule.

**YouTube Channel/ Class Playlist:** For your convenience and in case Blackboard is down, all videos that I upload onto Blackboard will also be available on the Class YouTube Playlist. Follow the following:

[https://www.youtube.com/playlist?list=PLooZ\\_5SWLanNguZobjw-evmp\\_BHT3KjKr](https://www.youtube.com/playlist?list=PLooZ_5SWLanNguZobjw-evmp_BHT3KjKr)

**Iclicker REEF:** You need to sign in to this Blackboard course and use the link created to sign in to your iClicker REEF account or create a new account if you don't already have one. Using the Blackboard link automatically adds this course to your account and you won't have to search for this course to join it. This is an important tool that will be used regularly for quizzes, polling, and attendance. You can use your own mobile device (laptop, tablet, or smartphone) or clicker to submit your responses to iClicker cloud. **It is important to remember that if you arrive late and an I-clicker quiz or attendance has been taken no arrangements can be made to accommodate tardiness or missing out on a quiz.**

**ABCD card:** Low-tech in class response system for just-in-time teaching. You will be given one copy. If you lose it, you need to reprint it. We will use ABCD cards for "just in time teaching" and quick polling when not using Iclicker REEF.

**Approved calculators:**

NCEES has approved the following list of calculators for use in the April and October 2013 exam administrations:

**Casio:** All fx-115 models. Any Casio calculator must contain fx-115 in its model name. Examples of acceptable Casio fx-115 models include but are not limited to the following:

- fx-115 MS
- fx-115 MS Plus
- fx-115 MS SR
- fx-115 ES
- fx-115 ES Plus

**Hewlett Packard:** The HP 33s and HP 35s models, but no others.

**Texas Instruments:** All TI-30X and TI-36X models. Any Texas Instruments calculator must contain either TI-30X or TI-36X in its model name. Examples of acceptable TI-30X and TI-36X models include but are not limited to the following:

- TI-30Xa
- TI-30Xa SOLAR
- TI-30Xa SE
- TI-30XS Multiview
- TI-30X IIB
- TI-30X IIS
- TI-36X II
- TI-36X SOLAR
- TI-36X Pro

### **Class format**

**Team Based Learning:** Team-based learning (TBL) is a structured form of small-group learning that emphasizes student preparation out of class and application of knowledge in class. Students will be organized into diverse teams of 5-7 students that work together throughout the semester. This is the same group you will have in your laboratory.

**Flipped classes:** We will often have flipped classes (especially when I am away on UTEP-related travel). That means that you need to study ahead of time the material that may include videos and complete in-class homeworks during the regular class time with a Teaching Assistant.

**Blackboard:** Please be aware that this is a very Blackboard-intensive course that will help you be engaged with the class outside the classroom. You need to make sure that you check Blackboard for homework announcements and deadlines. Generally, you will receive an e-mail with the announcement. If you have a smart phone, make sure you receive your UTEP e-mails on your phone so you have real-time announcements.

### **Assignments and quizzes**

**On-line homeworks.** On-line homeworks will announced on Blackboard and they can be in the form of an on-line homework or individual quiz

**Regular homeworks:** As stated earlier, most homeworks will submitted on-line using Blackboard. Nevertheless, some homeworks will be submitted on paper during the scheduled semester. If a homework is submitted late on the same day before COB, no points will be taken. **Homeworks turned in after the due date but no later than the following class will have 25% of the points taken off. No homeworks will be accepted after that.**

**RATs:** A RAT or a Rapid Assessment Test is an individual short-answer or multiple choice quiz given at the beginning of class. Usually a RAT will be followed by an group IF-AT (Immediate Feedback assessment test) or a group assessment quiz.

**Ticket to Class (TTC) Homeworks:** Homeworks classified as TTC homeworks must be turned in before the class starts. Make sure you know if it is a group TTC or an individual TTC. TTC homeworks submitted on paper, need to be turned in at the beginning of the class. TTC homeworks are usually problems that we started solving in the class but did not have time to complete. As soon as you come in place homework on the table without having to ask me. Make-up homeworks or homeworks turned in 15 minutes after the class starts will not accepted.

### **Exams and grades**

**Partial exams:** A minimum of three partial exams will be given. You must take the exams during the scheduled exam periods. These dates are announced on the first day of class although the dates may be changed according to the progress of the class. Do NOT make other plans on these days. Do NOT schedule personal airline flights on these days. You will NOT be excused for personal travel, only for UTEP-related travel. If you are not

present for the exam, you will receive a grade of zero. **No Make-up exam will be given under any circumstance (excused or unexcused).** Final exam grade will count for missing or lowest partial exam grade.

**Final Exam:** The final exam is a **closed book-closed note** comprehensive exam. Every student is required to take the final exam at the end of the semester and pass it with at least a grade of 50%, otherwise you get an F in the course.

**Attendance:** University policy dictates that all students attend all scheduled classes. Attendance can be checked randomly, and not necessarily in every class, by the instructor through sign-up sheets, exams, roll calling, randomly picked names for problem solving in class, or other mechanisms. **YOU AND ONLY YOU ARE RESPONSIBLE FOR SIGNING ATTENDANCE SHEETS, WHEN PASSED AROUND THE CLASS.** You need to be present at the moment of the roll call, otherwise it will be considered an absence. Additionally, all exams, and quizzes may be given at the beginning or end of the classes. No additional time nor make up quizzes will be given to late attendees or early leavers.

### **Grade Distribution:**

<b>Description</b>	<b>Content</b>	<b>Percent of Final Grade</b>
Homework, quizzes, class, and team participation (Peer evaluation)	Sections covered during the week. You may have either a homework, a quiz, team-work, or all in any given week.	<b>15%</b>
*Attendance	If you have more than 5 unexcused (non-UTEP-related) absences, you may get an F in the class.	
3 Partial Exams	Refer to Exam Schedule	<b>40%</b>
Projects	Refer to Blackboard for description of short group projects	<b>5%</b>
Laboratory	Laboratory exercises, includes attendance to field trips	<b>20%</b>
<b><u>Final Exam</u></b> <b><u>Thursday December</u></b> <b><u>12th<sup>th</sup></u></b> <b><u>10:00 am–12:45 pm</u></b>	Comprehensive	<b>20% but if you get less than 50% you get an F in the course</b>

**Grading Scheme:** The instructor reserves the right to revise this grading plan. However, students will be informed of any changes. Your final grade will be calculated based on the points you have accumulated as follows:

A	>89.5
B	>79.5 but <89.5
C	>69.5 but <79.5
D	>59.5 but <69.5
F	<59.5

**Note that 89.44 is B, 79.44 is C, 69.44 is D, 59.44 is F. This is where your bonus points come to your rescue!**

**A NOTE ON CLAIMS:** You have **two weeks after the due date to stop by my office in cases of claims in points** for homeworks (TTC, Blackboard Homeworks, IF-ATs, etc.). Also, you only have **two weeks after I return your graded exams to do this. The end of the semester or after the final exam is too late to come to my office to “fish” for extra points in homeworks or exams.**

### Class Policies

**Purpose:** These policies serve to help make the learning experience optimally effective and enjoyable for everyone.

**Professional conduct:** Be kinder than necessary! During this course, I expect you to deal with your peers and with me in a professional manner. Be courteous and honest and always communicate with each other in a way that shows respect and sensitivity to cultural, religious, sexual, and other individual differences. I expect you to come to class on time and stay focused on the lecture and learning activities.

**Cell Phones ringtones are OFF in Class:** First, professionals turn off their cell phone ringtones in a meeting with other professionals in order to give full attention to the discussion. Second, a ringing phone disrupts because the sound of a phone attracts attention. Disruptions of the learning process are annoying. Your meeting time in class is valuable, chat and text with your friends outside of your team meeting. However, **you will be using your laptops or smartphones during class for Iclicker REEF and to google information.**

**Use of Laptops:** If you do not have a smart phone, you will need to bring a laptop to class. Do not allow your laptop to disrupt your learning process! Do not surf the internet on topics not related to your class activities, or answer your email, instant message, facebook, video viewing, music playing, game playing, etc. These activities show a lack of respect for your classmates and myself, and also shows a disinterest in the course which is un-professional and un-acceptable. A few suggestions that will help the use of laptops in class:

1. Charge your laptop batteries fully before coming to class.
2. Set your laptop volume control to mute or off before coming to class.
3. Keep your laptop closed during presentations and other specific in-class activities.
4. If I see you playing games or surfing the net on subjects not related to the class, I have the right to ask you to leave the classroom.

**Be a premeditated learner!** Learning does not come from just listening, taking notes, and studying the night before the exam. Understand how you learn best and continuously improve on it. Make connections between the material covered in class and the world around you so you can make of this class not just a lecture but a life-learning experience.

**Cheating, Plagiarism, Scholastic Dishonesty, and Student Discipline:** Cheating is unethical and not acceptable. Plagiarism is using information or original wording in a paper without giving credit to the source of that information or wording: it is also not acceptable. Do not submit work under your name that you did not do



yourself, ever. You may not submit work for this class that you did for another class. If you cheated or plagiarized, you will be subject to disciplinary action as stated in the UTEP undergraduate catalog policy.

*“Scholastic dishonesty (which includes the attempt of any student to present the work of another as his or her own, or any work which s(he) has not honestly performed, or attempting to pass any examination by improper means) is a serious offense and will subject the student to disciplinary action. The aiding and abetting of a student in any dishonesty is held to be an equally serious offense. All alleged acts of scholastic dishonesty should be reported to the Dean of Students for disposition. It is the Dean of Students’ responsibility to investigate each allegation, dismiss the allegation, or proceed with disciplinary action in a manner which provides the accused student his or her rights of due process.”*

Refer to <http://www.utep.edu/dos/acadintg.htm> for further information.

You must cite, reference, or quote information obtained from other sources so you give credit where credit is due. If you do not know how to do that, ask. In addition, when an assignment specifies that you must perform a task individually, asking for your classmates’ help is scholastic dishonesty. Do NOT copy any material, regardless of where you obtained it, into your own work. Do NOT submit work under your name if you did not complete it entirely yourself; be honest and tell me you did it together. The consequences will be less severe when you are up front about it than when you try to hide it.

UTEP now has a site license for Turnitin.com, a plagiarism detection tool that you can also use to check your own work for this or other classes to prevent getting in trouble. I will report any instances of plagiarism and dishonesty to the Dean of Students Office and the grade for the assignment will be an “F” or “zero”.

If you want to test your understanding of plagiarism, take the self-assessment at <http://education.indiana.edu/~frick/plagiarism> or visit <http://www.turnitin.com>

### **Students with Any Type of Disability:**

UTEP seeks to provide reasonable accommodations for all qualified individuals with disabilities, including learning disabilities. This university will adhere to all applicable federal, state, and local laws, regulations and guidelines with respect to providing reasonable accommodations as required affording equal educational opportunity. It is the student's responsibility to register with Center for Accomodation and Support Services (CASS) in the East Union Bldg., Room 106 within the first two weeks of classes, and inform the faculty member to arrange for appropriate accommodations.

**Center for Accomodation and Support Services (CASS) can also be reached in the following ways:**

**Web:** <http://sa.utep.edu/cass/>

**Monday thru Friday 8:00a.m.-5:00p.m.**

**Union Building East Room 106**

**Phone:(915) 747-5148**

**[cass@utep.edu](mailto:cass@utep.edu)**

### **Time Management**

The tentative schedule contains practice problems. Expect to spend three hours on preparation and learning assignments for every semester credit hour. Since this class is a 3-semester credit hour class, expect to spend about 9-10 hours out of class on assignments in addition to 3 hours of in-class time for a total of about 12 hours per week to obtain an “A” in this class. One of your tasks is to develop a Time Management Plan for yourself. This means that you will:

- 1) Create a weekly calendar containing you class times, your work times, your family activities, your breakfast, lunch and dinner activities, your physical activities and exercise (no excuses, you are a Kinesiology major!), time to go shopping, etc.
- 2) Create a semester calendar for including the months of August, September, October, November, and Decemeber, in which you enter your weekly activities and the quizzes and exams for each of your courses. Create your plan and stick to it!!

## Tentative schedule (subject to change)

Week	Chapter or Topic	Suggested Practice problems. Check BB for additional practice problems	Laboratory
1 Aug 26-30	Team formation Set up IClicker REEF-attendance Field activity Chapter 1-Fundamental properties of water	1.3.2 to 1.3.9 1.5.2 and 1.5.4	NO LAB
2 Sept 2-6	Chapter 2 Water Pressure and Pressure forces, manometer. This chapter is a review of material covered in Fluid Mechanics, a prerequisite to this class.	2.2.2, 2.2.4, 2.2.6, 2.2.8, 2.4.1, 2.4.4, 2.4.7, 2.4.9, 2.5.1, 2.5.2, 2.5.9, 2.6.10	Buoyancy and Flow between tanks
3 Sept 9-13	Chapter 3: Water Flow in Pipes, major and minor losses	3.3.2, 3.3.4 3.5.1-2.8.8, 3.5.10 3.7.1, 3.7.7 3.11.1, 3.11.2, 3.11.5, 3.11.10 3.12.4	Rainwater harvesting
4 Sept 16-20	Chapter 3: Water Flow in Pipes, major and minor losses Chapter 4: Pipelines and Pipe Networks. Sections 4.1,4.2, 4.3, 4.5 (theory),	4.1.1,4.1.2, 4.2.5	Pipe Flow
5 Sept 23-27	Chapter 5 Water Pumps: System curves Review	5.1.2, 5.1.5,5.5.1,5.5.3,5.5.4,5.11.1	Stream flow (Field measurements)
6 Sept 30-Oct 4	Chapter 5: Pumps and pump curves <b>EXAM #1 (Chapters 1-5. Chapter 5 <u>system curves</u> only not pump curves): October 3<sup>rd</sup>, 2019</b>		Pump curve and system curve
7 Oct 7-11	Chapter 5: Pump and pump curves, continued Chapter 6: Water Flow in Open Channels. Manning Equation and Energy	6.2.1- 6.2.3,6.2.6,6.2.8,6.3.2,6.4.3,6.4.6,6.4.8, 6.5.2-6.5.6,6.9.1,6.9.2,6.9.4	Specific energy



Week	Chapter or Topic	Suggested Practice problems. Check BB for additional practice problems	Laboratory
8 Oct 14-18	Chapter 6: Water Flow in Open Channels. Specific Energy and Non Uniform Flow, Critical, sub-critical and supercritical flow, Hydraulic Jump, Opening of Spillway		Hydraulic jump
9 Oct 28-Nov1	Chapter 7: Groundwater Hydraulics	7.1.4,7.1.6,7.1.7,7.2.3-7.2.7,7.2.7.2.12,7.3.1,7.3.3	Steady flow to well
10 Nov 4-8	Chapter 8: Hydraulic structures Flipped Classroom <b>EXAM #2 (Chapters 5-system and pump curves, Chapter 6, 7) – Thursday November 1<sup>st</sup></b>	8.3.2,8.5.2-8.5.4,8.5.7,8.9.5	Flow under sheet pile
11 Nov 5-9	Chapter 9: Water Pressure, Velocity, and discharge measurements	9.1.2,9.2, 9.3.4.3, 9.3.5,9.4.1	Flow through weirs
12 Nov 11-15	Chapter 11 Hydrology and methods to estimate peak discharge	11.2.16, 11.1.3, 11.2.1-11.2.3,11.2.8,11.4.5, 11.4.10, 11.4.11,11.6.3,11.6.6, B1	Rainfall/Runoff Relationships
13 Nov 18-22	Chapter 11 Methods to estimate peak discharge		Unit hydrograph
14 Nov 25-29	Wrap up and review		NO LAB
15 Dec 2-6	<b>EXAM #3 (Chapters 7-12) – Thursday December 6<sup>th</sup></b>		NO LAB
	FINAL EXAM IS ON THURSDAY DECEMBER 12 <sup>TH</sup> FROM 10:00 AM-12:45 PM		

**I will let you know when I have UTEP-related travel. When I travel, you should have read the material before hand and be ready for an in-class homework with the TA.**

**GRADUATE STUDENT PROJECT: Please discuss with me on the first week of classes!**