JOHN A. REIF, JR. DEPARTMENT OF
CIVIL AND ENVIRONMENTAL ENGINEERING

NJIT New Jersey Institute of Technology

CE 320A – Hydraulics Laboratory – Spring 2018

Section 104, Friday–6:00 – 9:05 p.m. **Dr. Ashish Borgaonkar**

Introduction: Welcome to the CEE Hydraulics Laboratory. This is the place where you will "put to the test" the theory that you are learning in the classroom. The Hydraulics Laboratory course (CE 320A) is designed to complement the lecture portions of the three water-oriented courses: Fluid Mechanics (CE 320), Water Resources (CE 321), and Hydraulics Engineering (CE 322). The specific objectives of this course are to provide the student with an opportunity to:

1. Explore the fundamental principles of fluid mechanics through experimentation;
2. Demonstrate and analyze key hydraulic phenomena using hands-on physical devices and computer modeling;
3. Investigate engineering design principles for pipe networks, open channel systems, and ground water regimes;
4. Develop skills for analyzing experimental data and working in teams;
5. Learn to design a custom hydraulics experiment.

Fortunately, many real world hydraulic phenomena can be easily simulated at a reduced laboratory scale. This is due to the fact that fluids adhere quite closely to the principles of *engineering similitude*. Thus, the experiments in the CEE Hydraulics Laboratory provide an excellent opportunity for you to visualize and analyze the very same hydraulic phenomena that you are studying in class and will apply as practicing engineers.

Prerequisites: CE 320 is pre-requisite or co-requisite.

Textbook(s)/Materials Required:

1. *Hydraulics Laboratory Manual*, by J.R. Schuring and W.P. Shu, 2010.
2. *Fluid Mechanics with Engineering Applications*, Finnemore and Franzini, 10th Edition, McGraw-Hill.

Laboratory Assignments: Lab assignments will be given weekly and lab reports must be handed in by 6:00 p.m. of the following class, unless otherwise announced. <u>Late assignments will not be accepted</u>. Some lab reports will be written and submitted individually by the student. In completing individual reports, students in the same group will share data, <u>although all analyses and written text must be the student's own work</u>.* Several group-written reports will be assigned during the semester. For some experiments, an abbreviated assignment in a "lab problem" format will be used.

***Honor Code:** Students are advised that the NJIT Honor Code will be upheld in this course, and any violations will be brought to the immediate attention of the Dean of Students.

Grading Basis: Lab Reports and Lab Problems = 90%; Attendance & Class Participation = 10%

Contact Information:
Dr. Ashish Borgaonkar; Office: Colton Hall, Room 311; Office Hours: Tues. 5:00-6:00 p.m. Contact: 973-596-3467, ashish.borgaonkar@njit.edu.

COURSE OUTLINE

Week Beginning	Topics	Assignment	Report*
Jan. 16	General Orientation and Lab Safety; Manometer Principles **(6)**	Safety Procedures	LP
Jan. 22	Continuity and Flow Measurement **(3)**	Lab 4	LP
Jan 29	Viscosity of Liquids **(6)**	Lab 1	LR
Feb. 5	Weir Flow **(6)**	Lab 9	LP
Feb. 12	Hydrostatics: Archimedes Principle of Buoyancy **(4)**	Lab 3	LR
Feb. 19	Bernoulli's Principle and Equation: ▪ Torricelli and Bernoulli Tank Exp. **(6)** ▪ Venturi Apparatus **(1)**	Lab 5	LP
Feb. 26	Pipe Phenomena ▪ Friction Loss and Minor Losses (Class Exp.)	Lab 7	LR
Mar. 5	Hydraulic Jump, Translatory Waves & Water Hammer ▪ Flow Visualization Chamber (Class demo) ▪ C4 Flume **(1)** ▪ F1-10 Bench (**1**)	Lab 8	LP
Mar. 19	Manning's Equation **(1)**	Handout	GR
Mar. 26	Centrifugal Pump Network **(1)** Student-Designed Hydraulics Experiment Introduction	Lab 10 Lab 13	LP GR
To Be Announced	Stream Gaging – Field Exercise (6) (This will be held at Memorial Park in Nutley on a Saturday)	Lab 12	LP
Apr. 2	Student-Designed Hydraulics Experiment (cont.)	Lab 13	GR
Apr. 9	Student-Designed Hydraulics Experiment (cont.)	Lab 13	GR
Apr. 16	Student-Designed Hydraulics Presentation	Lab 13	GR
May 4-10	**FINAL EXAM PERIOD** (no final in this course)		

*Legend of Report Type:
LR = Individual lab report
LP = Individual lab problem
GR = Group lab report

Note: Students will be consulted on any substantial changes to the course syllabus. Changes will be discussed and announced in advance.

CE 320A – Hydraulics Laboratory

Description:

The course explores the principles of fluid mechanics through laboratory experiments, Investigates, various hydraulic phenomena with both physical and computer models. and demonstrates basic civil engineering design principles for pipe networks, open channel systems, and ground water regimes.

Prerequisites: CE 320 is prerequisite or corequisite.

Textbook(s)/Materials Required:

Laboratory Notes.

Course Objectives:

1. Learn the fundamental principles of fluid mechanics through experimentation.
2. Demonstrate hydraulic principles used in engineering design with hands-on physical devices and computer modeling.
3. Develop skills for analyzing experimental data, designing and conducting experiments, and working in teams.

Topics:

Orientation and Lab Safety
Fluid Properties: Viscosity, Surface Tension, and Capillarity
Hydrostatics: Archimedes Principle of Buoyancy: Pressure on a Submerged Gate
Reynold's Number
Bermoulli's Theorem; Minor Losses
Fluid Momentum and Drag on Bridge Piers
Pipe Network: A comparative Analysis
Water Hammer
Pump Experiment
Flow over Weirs
Open Channel Flow and Hydraulic Jump
Stream Gauging and Sediment Transport (Stream Table)
Aquifer Properties: Porosity and Permeability
Ground Water Modeling

Schedule: Laboratory – 3 hour class, once per week

Professional Component: Engineering Topics

Program Objectives Addressed: 1, 2

Prepared By: Prof. Schuring and Prof. Borgaonkar

Outcomes Course Matrix –CE 320A Hydraulics Laboratory

Strategies, Actions and Assignments	ABET Student Outcomes (1-7)	Program Educational Objectives	Assessment Measures
Student Learning Outcome 1: Identify and apply fundamental principles of fluid mechanics through experimentation.			
Conduct experiments that measure fluid viscosity, capillarity, surface tension, and pressure.	1, 6	1	Class participation, lab reports.
Apply different fluid measuring systems including transducers, rotameters, bordon-tube gages, weirs, sight-glasses, and hook-and point gages.	1, 6	1	Class participation, lab reports.
Student Learning Outcome 2: Demonstrate use of hydraulic principles used in engineering design with hands-on physical devices and computer modeling.			
Conduct experiments involving closed conduit flow, open channel flow, and groundwater flow.	1, 6	1	Class participation, lab reports.
Analyze experiments using hand calculations and computer models.	1, 6	1	Class participation, lab reports.
Student Learning Outcome 3: Develop skills for analyzing experimental data, designing and conducting experiments, and working in teams.			
Conduct fully interactive hydraulics experiments.	6	1	Class participation, lab reports.
Perform experiments in student groups that require exchange and analysis of data during the laboratory period, as well as after class.	5, 6	1, 2	Class participation, lab reports.
Students select/identify a problem topic, design and conduct their own experiment and present their findings.	5, 6	1, 2	Lab report and oral presentation.
Prepare written laboratory reports.	3	1, 2	Lab reports.

CEE Mission, Program Educational Objectives and Student Outcomes

The mission of the Department of Civil and Environmental Engineering is:

- to educate a diverse student body to be employed in the engineering profession
- to encourage research and scholarship among our faculty and students
- to promote service to the engineering profession and society

Our program educational objectives are reflected in the achievements of our recent alumni:

<u>1 – Engineering Practice:</u> Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.

<u>2 – Professional Growth:</u> Alumni will advance their skills through professional growth and development activities such as graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as business and law through further education.

<u>3 – Service:</u> Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Our Student Outcomes are what students are expected to know and be able to do by the time of their graduation:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Revised: 2/13/18