Course Number and Title: CET 240 Hydraulics and Hydrology

Campus Location:
Georgetown, Stanton

Effective Date:
2018-52

Prerequisite:
ENG 102, MAT 180, CET 125, CET 144

Co-Requisites:
none

Course Credits and Hours:
4.00 credits
3.00 lecture hours/week
3.00 lab hours/week

Course Description:
This course applies the basic principles of hydraulics as related to the design of pipe distribution systems. Topics include the sizing and selection of pumps, open channel flow, flow through hydraulic structures, the elements of hydrology, rainfall runoff analysis, drainage design, and flood flow analysis.

Required Text(s):
Obtain current textbook information by viewing the campus bookstore - https://www.dtcc.edu/bookstores online or visit a campus bookstore. Check your course schedule for the course number and section.

Additional Materials:
None

Schedule Type:
Classroom Course

Disclaimer:
None

Core Course Performance Objectives (CCPOs):

1. Describe the fundamental concepts of fluid mechanics. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
2. Compute hydrostatics, and explain how it relates to buoyancy and pressure. (CCC 2, 5, 6; PGC: CET 1; SET 1, 3; EET 1, 5; CTO 2, 5)
3. Explain hydrodynamic pressure and how the conservation of mass and the conservation of energy relate to this topic. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
4. Employ calculations to determine the flow of water through various hydraulic devices. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
5. Calculate the flow of a liquid through open channel flow.(CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
6. Differentiate the uniform flow of a liquid in a channel through the proper calculations. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
7. Calculate the flow of a liquid in an open channel with obstructions placed in the channel or varying channel conditions. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
8. Determine the flow of liquid through a culvert. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
9. Explain fundamental hydrologic concepts and their application to industry. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
10. Interpret the runoff of a site using calculations from the National Resources Conservation Service (NRCS) method and the Rational Method. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
11. Design a basic storm sewer system. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1)
12. Develop the design process of culverts in typical field applications. (CCC 2, 5, 7; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
13. Assess the detention of stormwater based on the concept of storing runoff temporarily and then releasing it in a controlled manner. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
14. Explain how detention basins are employed in the design of stormwater management. (CCC 2, 5, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
15. Demonstrate professional and ethical conduct as expected in industry. (CCC 1, 2, 3, 4, 5, 6; PGC: CET 1, 4, 5; SET 1, 3, 4, 6; EET 1, 3, 4; CTO 1, 2, 4)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency they develop.

Measurable Performance Objectives (MPOs):
Upon completion of this course, the student will:

1. Describe the fundamental concepts of fluid mechanics.

1. Explain the differences between liquids and gases.
2. Describe the properties of water such as cohesion, adhesion, and capillarity.
3. Calculate the specific weight and specific gravity of the various liquids.
4. Calculate the viscosity of a fluid.

2. Compute hydrostatics, and explain how it relates to buoyancy and pressure.
    1. Assess the pressure in water at various depths.
    2. Interpret the pressure on a submerged vertical surface.
    3. Interpret the pressure on an inclined surface.
    4. Determine the buoyant force on a submerged object.
3. Explain hydrodynamic pressure and how the conservation of mass and the conservation of energy relate to this topic.
    1. Determine the differences in water flow occurring in different circumstances.
    2. Determine the energy grade line and hydraulic grade line for a simple hydraulic system.
    3. Calculate the discharge and velocity of water flowing in a simple hydraulic system.
    4. Measure the discharge and velocity of water flowing in a simple hydraulic system.
4. Employ calculations to determine the flow of water through various hydraulic devices.
    1. Assess the flow of water through an orifice.
    2. Differentiate the flow of water over a weir.
    3. Interpret the flow of water under a gate.
    4. Calculate the flow of water in a siphon.
5. Calculate the flow of a liquid through open channel flow.
    1. Compute the slope of a channel.
    2. Compute the cross-sectional area, wetted perimeter, and hydraulic radius of a channel.
    3. Determine the normal depth in a channel.
    4. Identify and compute the critical depth in a channel.
6. Calculate the uniform flow of a liquid in a channel.
    1. Compute the normal depth in a channel or pipe.
    2. Compute the normal depth in a stream including over banks.
    3. Determine the sizes of a channel or pipe using the design charts.
7. Calculate the flow of a liquid in an open channel with obstructions placed in the channel or varying channel conditions.
    1. Identify water surface profiles for mild- and steep-sloped channels.
    2. Appraise the backwater profile using the standard step method.
    3. Compute a water surface profile at an entrance to a channel.
    4. Assess a basic hydraulic jump.
8. Determine the flow of liquid through a culvert.
    1. Identify the type of flow pattern in a culvert, and determine if it has inlet or outlet control.
    2. Determine the adequacy of flow through an existing culvert using both inlet and outlet control.
    3. Determine an adequate culvert size for a given discharge.
    4. Determine the need for increased inlet efficiency for a culvert flow condition.
9. Explain fundamental hydrologic concepts and their application to industry.
    1. Describe the hydrologic cycle.
    2. Determine and delineate a drainage basin on a topographic map.
    3. Calculate the time of concentration for a drainage area.
    4. Determine the storm frequency for a given rainfall intensity.
    5. Calculate a runoff hydrograph using a unit hydrograph.
10. Interpret the runoff of a site using calculations from the National Resources Conservation Service (NRCS) method and the Rational Method.
    1. Identify the peak runoff using the Rational Method.
    2. Assess the peak runoff using the NRCS method.
    3. Differentiate the runoff hydrograph using the Modified Rational Method.
    4. Calculate the runoff hydrograph using the NRCS method.
11. Design a basic storm sewer system.
    1. Determine the layout of a storm sewer system in a road or parking area.
    2. Determine a storm sewer profile.
    3. Differentiate incremental drainage areas in a standard storm sewer design.
    4. Calculate pipe sizes in a standard storm sewer design.
    5. Formulate riprap outfall protection areas for a storm sewer outlet.
12. Develop the design process of culverts in typical field applications.
    1. Assess an existing culvert for hydraulic capacity.
    2. Interpret plans showing a culvert profile.
    3. Determine an appropriate layout for a new culvert.
    4. Determine an appropriate layout for a culvert replacement.
    5. Formulate a design for a culvert size for a new embankment or a culvert replacement.
    6. Formulate a design for rip rap protection for a culvert inlet or outlet.
13. Assess the detention of stormwater based on the concept of storing runoff temporarily and then releasing it in a controlled manner.
    1. Formulate the impoundment volume by the elevation end area method.
    2. Assess the impoundment outflow using an orifice and a weir.
    3. Calculate reservoir routing by hand.

14. Explain how detention basins are employed in the design of stormwater management.
    1. Explain the difference between on-site and regional detention.
    2. Conduct a design calculation of a basic design basin.
15. Demonstrate professional and ethical conduct as expected in industry.
    1. Identify the need for self-discipline and time management in technical industries.
    2. Communicate and function effectively as a member of a team.

Evaluation Criteria/Policies:
Students must demonstrate proficiency on all CCPOs at a minimal 75 percent level to successfully complete the course. The grade will be determined using the Delaware Tech grading system:

92	**–**	**100**	**=**	**A**
83	**–**	**91**	**=**	**B**
75	**–**	**82**	**=**	**C**
0	**–**	**74**	**=**	**F**

Students should refer to the Student Handbook - https://www.dtcc.edu/handbook for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

Final Course Grade:
Calculated using the following weighted average

Evaluation Measure	Percentage of final grade
Unit 1 & 2 Exam (Summative Mid-Term Exam)	30%
Unit 3 & 4 Exam (Summative Final Exam)	30%
Chapter Quizzes (Summative)	15%
Assignments (Formative)	20%
Contextual Awareness (Formative)	5%
TOTAL	100%

Core Curriculum Competencies (CCCs are the competencies every graduate will develop):

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):
CETAASCET:

1. Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering activities, including but not limited to site development, hydraulics and hydrology, grading, and structural systems.
2. Conduct standardized field and laboratory testing on civil engineering project materials.
3. Select appropriate materials and estimate material quantities for technical projects.
4. Use graphic techniques and productivity software to produce engineering documents.
5. Demonstrate a commitment to quality, timeliness, professional development, and continuous improvement.

CETAASSET:

1. Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities, including but not limited to site development, hydraulics and hydrology, grading, and structural systems.
2. Conduct standardized field and laboratory testing on civil engineering project materials.
3. Select appropriate materials and estimate material quantities for technical projects.
4. Use graphic techniques and productivity software to produce engineering documents.
5. Integrate appropriate surveying methods for land measurement and/or construction layout and the acquisition of spatial data in accordance with the laws and regulations pertaining to Professional Land Surveying.
6. Demonstrate a commitment to quality, timeliness, professional development, and continuous improvement.

ENVAASEET:

1. Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering activities, including but not limited to site development, hydraulics and hydrology, grading, water and wastewater treatment, pollution prevention and treatment, and sustainable design.
2. Conduct standardized field and laboratory testing.
3. Demonstrate a commitment to quality, timeliness, professional development, and continuous improvement.
4. Use graphic techniques and productivity software to produce technical documents.
5. Explain the major aspects of the normal ecology of the planet and risks associated with polluting the environment.
6. Apply current federal, state and local environmental and safety regulations and industry best management practices.

CETAASCTO:

1. Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering activities, including but not limited to site development, hydraulics and hydrology, grading, and structural systems.
2. Use graphic techniques and productivity software to produce engineering documents.
3. Apply fundamentals of science and mathematics to solve engineering problems.
4. Demonstrate a commitment to quality, timeliness, professional development, and continuous improvement.

Disabilities Support Statement:
The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the disabilities services - https://www.dtcc.edu/disabilitysupport web page or visit the campus Advising Center.