Course Number and Title: CET 240 Hydraulics and Hydrology

Campus Location:
Georgetown, Stanton

Effective Date:
2022-51

Prerequisite:
ENG 102, (MAT 183 or higher), CET 125

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, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
2. Calculate hydrostatics and explain how it relates to buoyancy and pressure. (CCC 2, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
3. Describe hydrodynamic pressure and how the conservation of mass and the conservation of energy relate to this topic. (CCC 2, 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, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
5. Calculate the flow of a liquid through open channel flow.(CCC 2, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
6. Calculate the flow of a liquid in an open channel with obstructions placed in the channel or varying channel conditions. (CCC 2, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
7. Determine the flow of liquid through a culvert. (CCC 2, 6; PGC: CET 1; SET 1; EET 1; CTO 1, 3)
8. Explain the fundamentals of watershed hydrology and their application to industry. (CCC 1, 2, 6; PGC: CET 1, 3, 4, 5; SET 1, 3, 4, 6; EET 1, 3, 4, 6; CTO 1, 2, 3, 4)
9. Calculate the runoff of a site using calculations from the National Resources Conservation Service (NRCS) method and the Rational Method. (CCC 1, 2, 4, 6; PGC: CET 1, 3, 4, 5; SET 1, 3, 4, 6; EET 1, 3, 4, 6; CTO 1, 2, 3, 4)
10. Apply the principles of a basic storm sewer system design. (CCC 1, 2, 4, 6; PGC: CET 1, 4; SET 1, 4; EET 1, 4; CTO 1, 2, 3)
11. Assess the detention of stormwater based on the concept of storing runoff temporarily and then releasing it in a controlled manner. (CCC 1, 2, 4, 6; PGC: CET 1, 3, 4, 5; SET 1, 3, 4, 6; EET 1, 3, 4, 6; CTO 1, 2, 3, 4)
12. Employ a variety of standard erosion and sediment control measures based on specific design criteria. (CCC 1, 2, 4, 5, 6; PGC; CET 1, 3, 5; SET 1, 3, 6; EET 1, 3, 6; CTO 1, 3, 4)
13. Demonstrate professional and ethical conduct as expected in industry. (CCC 1, 2, 4, 6; PGC: CET 1, 4, 5; SET 1, 3, 4, 6; EET 1, 3, 4, 6; 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. Identify 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. Define the viscosity of a fluid.
2. Calculate hydrostatics and explain how it relates to buoyancy and pressure.
    1. Calculate the pressure in water at various depths.
    2. Calculate the pressure on a submerged vertical surface.
    3. Calculate the pressure on an inclined surface.
    4. Calculate the buoyant force on a submerged object.
3. Describe hydrodynamic pressure and how the conservation of mass and the conservation of energy relate to this topic.
    1. Determine the energy grade line and hydraulic grade line for a simple hydraulic system.
    2. Calculate 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. Calculate the flow of water through an orifice.
    2. Calculate the flow of water over a weir.
    3. Discuss the flow of water under a gate and in a siphon.
5. Calculate the flow of a liquid through open channel flow.
    1. Differentiate between uniform flow and non-uniform (varied) flow in an open channel.
    2. Calculate the slope of a channel or pipe.
    3. Calculate the cross-sectional area, wetted perimeter, and hydraulic radius of a channel or pipe.
    4. Calculate the normal depth in a channel, pipe, or stream including over banks.
    5. Calculate the critical depth in a channel or pipe.
    6. Determine the size of a channel or pipe using design charts.
6. 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. Identify circumstances that would result in a backwater profile and hydraulic jump.
    3. Calculate a water surface profile at an entrance to a channel.
7. 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.
    5. Formulate a design for a culvert size for an embankment or a culvert replacement.
    6. Formulate a design for rip rap protection for a culvert inlet or outlet.
8. Explain the fundamentals of watershed hydrology and their application to industry.
    1. Explain the hydrologic cycle.
    2. Explain a watershed's role in the hydrologic cycle, including hydrologic unit codes (HUC) & their hierarchy.
    3. Determine and delineate a drainage basin on a topographic map.
    4. Identify land cover conditions within a drainage basin, including soil type and perviousness.
    5. Interpret land cover conditions within a drainage basin and their impact on runoff before and after development, include volume, velocity, and pollutants.
    6. Calculate a runoff hydrograph for a drainage basin using a unit hydrograph.
9. Calculate the runoff of a site using the National Resources Conservation Service (NRCS) method and the Rational Method.
    1. Calculate the time of concentration for a drainage area using the NRCS method and the Rational method.
    2. Determine the rainfall intensity for a given rainfall duration and return period.
    3. Calculate the peak runoff using the NRCS method and the Rational Method.
    4. Calculate the runoff hydrograph using the NRCS method.
10. Apply the principles of a basic storm sewer system design.
    1. Identify standard types of pipe materials and their applications.
    2. Determine the layout of a storm sewer system in a road or parking area.
    3. Determine a storm sewer profile.
    4. Determine incremental drainage areas in a standard storm sewer design.
    5. Calculate pipe sizes in a standard storm sewer design.
11. Assess the detention of stormwater based on the concept of storing runoff temporarily and then releasing it in a controlled manner.
    1. Differentiate between storage and infiltration.
    2. Describe common stormwater best management practices.
    3. Determine the impoundment volume by the elevation end area method.
    4. Calculate the impoundment outflow using an orifice and a weir.
    5. Calculate reservoir routing by hand.
12. Employ a variety of standard erosion and sediment control measures based on specific design criteria.
    1. Describe standard erosion and sediment control measures utilized in stormwater management systems.
    2. Formulate riprap outfall protection areas for a storm sewer outlet
13. 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:
The grade will be determined using the Delaware Tech grading system:

90	–	100	=	A
80	–	89	=	B
70	–	79	=	C
0	–	69	=	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
Summative: Tests	45%
Summative: Green Best Management Practices Research Project Presentation	10%
Summative: Final Project	15%
Formative: Assignments	30%
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.