Course Number and Title: MET 241 – Fluid Mechanics

Campus Location:
Stanton

Effective Date:
2018-51

Prerequisite:
MET 132, PHY 205

Co-Requisites:
None

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

Course Description:
This course covers physical properties of fluids, pressure and static forces, laminar and turbulent incompressible flow, conservation of energy and mass, design of fluid piping systems, energy losses, pump characteristics and selection, and heat transfer.

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. Define and calculate various physical properties of fluids, including specific weight, mass density, specific gravity, and viscosity. (CCC 1, 2, 5, 6; PGC 1, 11)
2. Analyze various applications in the field of fluid statics, including the determination of parameters such as absolute and gage pressure, vacuum, static head, manometric calculations of pressure, and static forces on submerged areas due to fluid pressure. (CCC 1, 2, 3, 5, 6; PGC 1)
3. Analyze various applications in the field of fluid dynamics; determine appropriate dynamic variables using the principles of mass, weight, and volume flow rates; conservation of mass (continuity equation); and conservation of energy (Bernoulli's and general energy equation). (CCC 1, 2, 3, 6; PGC 1, 9, 11)
4. Determine various energy losses involved in both laminar and turbulent flow, including the calculation of parameters such as Reynold's number, friction factor, friction loss, and minor losses due to valves, fittings, and changes in conduit size and configuration. (CCC 1, 2, 3, 4, 5, 6; PGC 1, 9, 11)
5. Differentiate among various types of pumps, describing the parameters involved in pump selection; select the appropriate centrifugal pump for given applications using manufacturers' pump curves. (CCC 1, 2, 5, 6; PGC 1,11)
6. Analyze the transfer of heat during conduction and convection phase changes, and calculate appropriate parameters such as heat added or removed, heat flow rate, thermal conductance and resistance, film coefficient, and Prandtl number. (CCC 1, 2, 5, 6; PGC 1,11)

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. Define and calculate various physical properties of fluids, including specific weight, mass density, specific gravity and viscosity, etc.
    1. Explain the basic definition of pressure and solve associated problems.
    2. Describe the nature of and calculate various physical characteristics of fluids, including specific weight, mass density, specific gravity, dynamic and kinematic viscosity.
2. Analyze various applications in the field of fluid statics, including the determination of parameters such as absolute and gage pressure, vacuum, static head, manometric calculations of pressure and static forces on submerged areas due to fluid pressure.
    1. Distinguish between absolute and gage pressure.
    2. Describe the relationship between pressure and elevation, including Pascal's paradox, and solve associated problems.
    3. Solve for fluid pressures in various systems using the principles of manometry.
    4. Calculate the total resultant force and center of pressure due to the exertion of fluid pressure on various submerged areas.
3. Analyze various applications in the field of fluid dynamics; determine appropriate dynamic variables using the principles of mass, weight, and volume flow rates; conservation of mass (continuity equation); and conservation of energy (Bernoulli's and general energy equation).
    1. Determine weight, mass, and volume flow rates for various fluid flow situations.
    2. Calculate conduit sizes, velocities, areas, and flow rates using the continuity equation.
    3. Fully describe each term in Bernoulli's equation, and apply it in solving for pressures, elevations, and velocities associated with various fluid flow configurations.
    4. Determine the time required to gravity drain a vented or pressurized vessel due to a constantly changing head.
    5. Fully describe each term in the general energy equation, and apply it in solving for pressures, elevations, velocities, and energy requirements associated with various fluid flow configurations.
    6. Determine the power required by pumps and associated pump efficiencies for various fluid flow configurations.
    7. Using both Darcy's and the Hagen-Poiseuille equations, calculate the friction head loss in circular conduits for various flow configurations involving both laminar and turbulent flow.
    8. Calculate the velocity and flow rate of water for various flow rate conditions using the Hazen-Williams formula as well as by using appropriate nomographs.
4. Determine various energy losses involved in both laminar and turbulent flow, including the calculations of parameters such as Reynold's number, friction factor, friction loss, and minor losses due to valves, fittings, and changes in conduit size and configuration.
    1. Distinguish the characteristics of laminar and turbulent flow.
    2. Calculate the Reynolds number for various fluid flows through circular conduits.
    3. Calculate the Reynolds number for various fluid flows through non-circular conduits.
    4. Identify the limiting values of the Reynold's number determining laminar or turbulent flow conditions.
    5. Using the parameters of velocity, resistance coefficient, and system geometry, calculate the energy losses for fluid flow through various conduits: enlargements, contractions, entrance and exit, valves, and fittings.
    6. Using the general energy equation, determine pressures, elevations, velocities, energy gains and losses, and power requirements associated with various fluid flow configurations.
5. Differentiate among various types of pumps, describing the parameters involved in pump selection; select the appropriate centrifugal pump for given applications using manufacturers' pump curves.
    1. Describe the primary parameters involved in pump selection.
    2. Differentiate between positive displacement and kinetic pumps.
    3. Select the appropriate centrifugal pump for given applications using manufacturer's pump curves involving total head, capacity, power rating, and efficiency.
6. Analyze the transfer of heat during conduction and convection phase changes, and calculate appropriate parameters such as heat added or removed, heat flow rate, thermal conductance and resistance, film coefficient, and Prandtl number.
    1. Define the following terms: *heat of fusion, heat of vaporization, condensation, conduction, thermal conductivity, convection radiation, thermal resistance,* and *boundary layer.*
    2. Fully describe the temperature-heat relationships during changes in state from solid, liquid, and vapor.
    3. Calculate the heat removed or added and the rate of heat removed or added to effect various changes in state.
    4. Differentiate between natural and forced convection.
    5. Calculate the rate of heat flow due to conductance in various situations.
    6. Calculate the rate of heat flow due to convection in various situations.
    7. Calculate the rate of heat loss or gain in a fluid under turbulent flow conditions.
    8. Differentiate among parallel, counter, and cross flow heat exchangers.
    9. Describe the nature and application of log mean temperature difference (LMTD).
    10. Describe the general construction of shell and tube heat exchangers.

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.

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):

1. Use effective problem-solving skills and make appropriate decisions relative to the technical field.
2. Design basic mechanical systems with the use of computer-aided drafting equipment.
3. Demonstrate basic computer literacy and knowledge of computer software applications in both the business and technical fields.
4. Use hand and power tools for standard manufacturing operations.
5. Conduct basic machining and welding operations; and perform basic programming of computer/numerically-controlled machines.
6. Calculate forces, properly size structures and mechanical components, and perform standard materials testing procedures.
7. Demonstrate an understanding of basic AC and DC electrical control circuits.
8. Select appropriate materials for basic mechanical applications.
9. Review and/or design basic hydraulic/pneumatic power systems.
10. Select basic machine components for mechanical systems.
11. Exhibit professional traits, including the ability to work with minimal supervision, willingness to learn new skills and contributing to team project efforts.

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.