

Module Code	MEU22E05
Module Name	Thermo-fluids
ECTS Weighting	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Assistant Prof. Seamus O'Shaughnessy (OSHAUGSE@tcd.ie)
<u>Module Learning Outcomes</u> with reference to the <u>Graduate Attributes</u> and how they are developed in discipline.	<p>On successful completion of this module, students should be able to:</p> <p>LO1. Analyse, solve problems, and communicate the solutions of simple fluid-based engineering problems.</p> <p>LO2. Understand the principal of basic fluid measurement devices.</p> <p>LO3. Determine forces generated in systems such as jets and propellers.</p> <p>LO4. Distinguish between ideal and real flows and evaluate practical problems associated with pipe flow systems.</p> <p>LO5. Conceptualise and describe practical flow systems such as boundary layers and their importance in engineering analysis.</p> <p>LO6. Evaluate thermo-fluid properties and solve basic problems using property tables, property diagrams and equations of state.</p> <p>LO7. Analyse, solve problems, and communicate the solutions to practical closed systems and steady-flow devices by applying the conservation of energy principle.</p> <p>LO8. Understand the limitations of engineering devices and systems based on the 2nd law of thermodynamics.</p> <p>LO9. Understand the concept of thermal efficiency and coefficient of performance and the environmental and socio-economic implications associated with desired system output (i.e. power/cooling) verses required 'cost' in.</p> <p>LO10. Understand basic laboratory procedure and safety.</p> <p>LO11. Acquire, tabulate and analyse useful data in the laboratory, and communicate information and provide physical interpretation of measurements in technical laboratory reports.</p> <p>Graduate Attributes: levels of attainment</p> <p>To act responsibly - Introduced</p> <p>To think independently - Enhanced</p> <p>To develop continuously - Enhanced</p> <p>To communicate effectively - Enhanced</p>

Module Content

Fluid Mechanics

- Introduction: Definition of a fluid, fluid properties, equation of state.
- Principles and Equations of Fluid Motion and their applications: Description of fluid flow, continuity equation, Euler and Bernoulli equations, Pitot total head and static tubes, venturi-meters, orifice plates.
- Momentum Equation & its application: Momentum equation for steady flow, applications to jet flows, impinging flows in pipe bends, momentum theory of propellers.
- Flow Regimes and Pipe Flow: Laminar and Turbulent Flows, Reynolds demonstration of flow regimes, criterion for laminar/ turbulent flow, Reynolds number, pipe flows, fully developed flow, laminar pipe flow, turbulent pipe flow, friction factor, friction losses, other losses.
- Boundary Layers and Wakes: Description of the boundary layer, laminar and turbulent boundary layers, physical, displacement & momentum thickness, effect of pressure gradient – separation and wake formation, drag forces.

Thermodynamics

- Introduction: Properties of matter, the state postulate, forms of energy, processes, thermodynamic systems,
- Properties of Pure Substances: property tables, property diagrams, phase change, equations of state (ideal gas), specific heats.
- Energy: Energy transfer by heat, work and mass, flow work.
- The First Law of Thermodynamics: Closed system, open system, steady-flow engineering devices.
- The Second Law of Thermodynamics: Statements of the Second Law, heat engines, refrigeration devices, reversible versus irreversible processes, the Carnot cycle.

Teaching and Learning Methods

The module encompasses a diverse variety of teaching and learning strategies. This is accomplished by coordinating formal lectures with teamwork-based problem-solving tutorial sessions supplemented by 'hands-on' laboratory experimentation and technical report writing. Students can avail of self-assessment online quizzes for every section of the module.

Associated laboratory/project programme

- Spark Ignition Engine Test.
- Comparison of Flow Measurement Systems.

Assessment Details¹ Please include the following: <ul style="list-style-type: none"> • Assessment Component • Assessment description • Learning Outcome(s) addressed • % of total • Assessment due date 	Assessment Component	Assessment Description	LO Addressed	% of total	Week due
	Exam	End of Semester Written or Real Time Online Exam	1 - 9	70	Exam Period
	Continuous Assessment	Lab Report	10 - 11	10	2 weeks after lab
	Continuous Assessment	Online Quizzes	1 - 9	20	Teaching Weeks 3,6,9,12
Reassessment Requirements	The reassessment mode for this module is a written or real time online examination worth 100% of the reassessment grade.				
Contact Hours and Indicative Student Workload¹	Contact hours: 45 total (33 lectures, 10 tutorials, 1 x 2 hour laboratory sessions)				
	Independent Study (preparation for course and review of materials): 35				
	Independent Study (preparation for assessment, incl. completion of assessment): 45				
Recommended Reading	See Blackboard for further information				
Module Pre-requisite	None				
Module Co-requisite	None				
Module Website	https://www.tcd.ie/Engineering/assets/module-descriptors/sf/MEU22E05.pdf				
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.					
Module Approval Date					
Approved by					
Academic Start Year					
Academic Year of Date	2021/2022				

¹ [TEP Guidelines on Workload and Assessment](#)