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

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 2nd Law of Thermodynamics: Statements of the 2nd 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. Students can avail of self-assessment online quizzes for every section of the module. **Associated laboratory/project programme** (dependent on the availability of appropriate laboratory demonstrators, and subject to capacity in the E3 Learning Foundry): • Spark Ignition Engine Test. • Comparison of Flow Measurement Systems. • Computational Fluid Dynamics case study

Assessment Details[1]
Please include the following:

- **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 Invigilated PC-based Exam through Blackboard	1 - 9	70	Exam Period
Continuous Assessment	Lab assignment or quiz	10 - 11	10	2 weeks after lab/assignment
Continuous Assessment	Online Quizzes (1 on fluid mechanics, 1 on thermodynamics)	1 - 9	20	Teaching Weeks 7,12

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 Workload[1]

Contact hours: 45 total (33 lectures, 10 tutorials, 1 x 2-hour laboratory sessions)
Independent Study (preparation for course & 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/current-students/undergraduate/engineering/year-two/

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

2024/2025

[1] TEP Guidelines on Workload and Assessment