

5B3 ADVANCED THERMAL FLUID SCIENCES

Lecturers: Assist. Prof. Anthony Robinson (arobins@tcd.ie),

Module Organisation

The module runs for 12 weeks of the academic year and comprises three lectures per week. A tutorial is given every week. Total contact time is 44hours.

| Semester | Start Week | End Week | Lectures per week | Lectures total | Tutorials per week | Tutorials total |
|----------|------------|----------|-------------------|----------------|--------------------|-----------------|
| 2 | 1 | 12 | 3 | 33 | 0 | 0 |

Module Description

This module is developed to deepen the student's understanding of heat and mass transfer as well as their capacity to solve complex engineering problems associated with real life thermal fluid systems. The module structure is primarily continuous assessment centred on problem-based learning. The group assignments and laboratory will pull together knowledge and understanding of thermodynamics, fluid mechanics and heat transfer by posing open ended and real life thermal fluid system problems that require bespoke engineering solutions. The problems will coordinate technical performance requirements with plausible real life constraints such as size/weight, material compatibility, manufacturability, cost etc. The group assignments will encourage the use of internet resources and archived journal publications to find new and/or unconventional techniques for their design with the aim of fostering innovative thinking while bringing the students up to speed with regard to the state of the art of both commercially available high technologies as well as emerging high technology.

Learning Outcomes

On successful completion of this module, students will (be able to):

1. Solve problems for practical and industrially relevant thermal fluids applications;
2. Analyse and generate closed mathematical models of heat transfer, fluid dynamic and thermodynamic systems by implementing and testing simplifying assumptions.
3. Design bespoke thermal management solutions to multidisciplinary problems with rigid constraints (cost, size/weight, manufacturability etc.).
4. Use online resources and archived publication records to research conventional and unconventional methods and technologies.
5. Understand the dynamics of teamwork in the context of solving multifaceted problems with rigid cost constraints and deadlines.
6. Communicate design concepts and performance predictions in the form of technical reports and formal presentations;

7. Design experiments and acquire, tabulate and analyse useful data in the laboratory;
8. Communicate information and provide physical interpretation of measurements in technical laboratory reports;

Module Content

- Problem-based learning design problems and group learning
- Experimental design, instrumentation, data acquisition, data reduction and experimental uncertainty

Teaching Strategies

The module encompasses a range of teaching and learning strategies. This is accomplished by posing design-based problem solving sessions supplemented by 'hands-on' laboratory experimentation, technical report writing, laboratory report writing and formal presentations. The module is delivered in a technologically up-to-date fashion by providing access to internet resources (e.g. Scopus), computational resources (MS Office, Matlab, CAD, FE & CFD software etc.).

Assessment Modes

Written examination, group design assignments and one laboratory experiment (with logbook and formal written report).

Recommended Texts

- Cengel and Turner, *Fundamentals of Thermal Fluid Sciences* (McGraw-Hill)

Other Relevant Texts

- Cengel and Bowles, *Thermodynamics: an Engineering Approach* (McGraw-Hill)
- Incropera & DeWitt, *Introduction to heat Transfer* (Wiley)
- White, *Fluid Mechanics* (McGraw-Hill)

LABORATORIES

- Thermal Fluids Lab

ASSESSMENT MODE(S)

Written Exam (15%) Continuous Assessment (85%)