Module Title: 4B21 Thermal Engineering and Technology

Code: ME4B21

Level: Senior Sophister (Optional module)

Credits: 5

Lecturer(s): Professor Tony Robinson (arobins@tcd.ie)

Module Organisation
This module runs for the 12 weeks of semester two (except during study/assignment week) and comprises three lectures plus one one-hour tutorial per week together with one three-hour laboratory. Total contact time is 47 hours.

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<th>Semester</th>
<th>Start Week</th>
<th>End Week</th>
<th>Associated Practical Hours</th>
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<td>2</td>
<td>1</td>
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<td>Lectures</td>
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<td>3</td>
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Total Contact Hours: 47

Module Description, Aims and Contribution to the Programme
This module is developed to deepen the student’s understanding of engineering technology, here in the context of thermal devices and technologies in the thermal sector. This will enhance student’s capacity to solve complex engineering problems using knowledge and techniques developed throughout their studies. The aim of this course is not to introduce new physics or mathematical concepts, but rather on how the physics and mathematics that has already been learned can be applied to predict the performance of engineering devices and technologies. The course structure is a healthy mix of traditional lectures, problem solving sessions, individual and group assignments, a hands-on laboratory and final exam. The individual and group assignments and laboratory will pull together knowledge and understanding of design, thermodynamics, fluid mechanics and heat transfer in the context of current industrial technology challenges and engineering solutions to everyday problems. The individual and group assignments will encourage the use of internet resources and archived journal publications to better understand new and/or unconventional techniques for advanced thermal hardware 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 completion of this module, the student will be able to:
1. Solve problems for practical and industrially relevant thermal engineering applications;
2. Analyse and generate closed thermal network models of heat transfer, fluid dynamic and thermodynamic systems by implementing and justifying simplifying assumptions;
3. Understand the thermal engineering design process;
4. Use online resources and archived publication records to research conventional and unconventional methods and technologies;
5. Understand the dynamics of individual and team work in the context of understanding a new, and possibly unconventional, high technology;
6. Communicate concepts and performance predictions in the form of an individual and group report and formal group presentation;
7. Communicate information and provide physical interpretation of measurements in technical laboratory reports.

Module Syllabus
- Thermal network modelling of mixed heat transfer devices;
- Heat pipes and thermosyphons;
- Microfluidic heat exchangers;
- Contact and constriction resistance and thermal interface materials;
- Heat spreaders;
- Fluid loop systems with remote heat exchanger;
- Electronics cooling.

Teaching Strategies
The module encompasses a range of teaching and learning strategies. This is accomplished by coordinating podium-style lectures with problem solving sessions. These will be supplemented by ‘hands-on’ laboratory experimentation, technical report writing, laboratory report writing and formal presentation. 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.).

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

Other Relevant Text(s)
- Cengel and Bowles, Thermodynamics: an Engineering Approach (McGraw-Hill)
- Incropera & DeWitt, Introduction to Heat Transfer (Wiley)
- White, Fluid Mechanics (McGraw-Hill)

Assessment
This module is assessed by a formal written two-hour examination (60% of the final mark), individual assignment (10%), pop quiz (5%), group presentation (10%) and a laboratory report (15%).

Laboratory
Thermal Fluids Laboratory