Department of Aerospace and Mechanical Engineering

ame.nd.edu/seminars

Making Sense of the Laws of Thermo-dynamics and Statistical Mechanics

Mr. John Dartnall
Mechanical and Manufacturing Engineering
University of Technology Sydney, Australia

Tuesday, November 12, 2013, 3:30P.M.

Lower Level Auditorium,

Geddes Hall

Refreshments served at 3:00 p.m. in the Geddes Hall Coffee House

The main users of Engineering Thermodynamics are mechanical and chemical engineers. Engineering thermodynamics courses almost always take a classical, macroscopic approach, by deriving useful relationships and procedures involving bulk properties and processes from the three Laws of Thermodynamics. The resultant relationships and procedures are useful, for example, in the design of internal combustion engines, steam turbines and power station plant and air conditioning equipment for mechanical engineers as well as in combustion processes and the design and selection of reaction vessels, evaporators, heat exchangers and other chemical equipment for chemical engineers.

Whilst very useful, this approach leads to the development of many new properties which unfortunately students find difficult to conceptualise, particularly entropy. As a result, students find Thermodynamics a demanding and uninteresting subject. In an attempt to remove this impediment and "explain" the properties the mathematically and conceptually complex Statistical Thermodynamics were put into introductory courses in thermodynamics, but, have not proved fruitful. Further, since it is considered that the entire teaching time is required to cover the macroscopic approach, the use of Statistical Thermodynamics as a teaching tool for engineers has generally been abandoned.

We have been working on one and two dimensional, simulations involving only newtonian mechanics that "demonstrate" that the laws and processes of thermodynamics are the consequence of the molecular structure of matter, without the need for the mathematically complicated approach of Statistical Mechanics. On the assumption of hard sphere interactions and the conservation of energy, students can build their own, easily visualised, molecular dynamic computer models and run them. They can thereby simulate molecular behaviour that supports the empirically developed universal gas law, state path laws and the Second Law, including entropy and many of its consequences, as well other processes, such as mechanism of conduction heat transfer. These experiments allow the student to develop simple explanations of the difficult to understand concepts of thermodynamics such as entropy and temperature.

If you are interested in meeting individually with Mr. Dartnall, please contact Linda at 631-5431.