Year 2 thermodynamics course descriptions

Lecture details

Timetable: No fixed timetable but usually three lectures per week

Duration: The course runs from week 1 to week 8 in the 1st term

Number of lectures: 20 lectures at 50 minutes each plus one revision lecture in May

Sections: The course is split into 20 sections each of variable length

Course notes: Course notes are given out for the whole course and also put on Blackboard. The course notes contain the essential information but you will be expected to add to them on occasions. After the lecture there will sometimes be minor modifications made to the notes. The modified notes will not be distributed but will appear on Blackboard and you will be notified of amendments.

Problem sheets: Rather than distribute separate problem sheets, questions are included at the end of each section in the notes. These are not assessed. They are designed to assist with your knowledge and understanding of the course and are to be completed in your own time and possibly in academic tutorials. They are usually split into three types: (1) Discussion Questions, (2) Numerical Questions and (3) Problems. Solutions to (2) and (3) will appear on Blackboard shortly after the notes are distributed in lectures. It is entirely up to you when you choose to use the solutions and how you use them. No full solutions will be presented for Discussion Questions – many won’t lend themselves to full solutions but sometimes suggestions or thoughts on the concepts may be included.

Assessed problem sheets: There are six assessed problems for the course given out in the final lecture of the week for the first six weeks. Four are multiple-choice questions for completion on Blackboard and two are for handing in and marking.

Discussion problems: These are pieces of non-assessed taught exercises given over 50 minutes designed for completion in the tutorials (thought the tutor does not have to use them if they don’t want to). They are designed to enhance your learning of the subject and may well investigate areas that aren’t directly from the lecture notes. They do however form part of the syllabus. Full solutions will appear on Blackboard at the end of the relevant tutorial week.

Summer exam: The majority of the summative assessment for the course comes from the Thermodynamics and Statistical Physics exam in week 6 of term 3
Aims and objectives

- To understand the importance of thermodynamics and its place in physics
- To further an understanding of heat flow and develop an understanding of entropy changes with an appreciation of how to analyse systems and solve problems to a level suitable for a second year Imperial College physics undergraduate
- To appreciate the limitations of thermodynamics and be ready to develop an understanding of statistical physics following on from the course

There are five branches of physics that are the building blocks of the subject that every physicist must know. These are:

1) Classical Mechanics
2) Special Relativity
3) Electromagnetism
4) Quantum Mechanics
5) Thermodynamics and Statistical Mechanics

and have been listed roughly in the order that it is necessary to learn them in. Much of the first two years of the IC Physics degree is devoted to making sure you have a firm grounding in these five areas. Structure of Matter was your first formal undergraduate inroad into Thermodynamics; this term see the final two topics given their own lecture courses.

Assumed prior knowledge

All of the core first year course material, including both the mathematics and the physics

Syllabus

1: An overview of thermodynamics
2: Temperature, internal energy and entropy
3: Equations of state
4: Conduction, convection and radiation
5: Phase changes
6: The first law of thermodynamics
7: Generalised variables
8: The second law of thermodynamics
9: The Carnot cycle
10: Other thermodynamic cycles
11: Chemical potential
12: Other thermodynamic potentials
13: The Maxwell relations
14: More on phase changes; the Clausius-Clapeyron relation
15: The third law of thermodynamics
16: The arrow of time
17: Back to temperature, internal energy and entropy
18: Photon gases
19: Thermodynamics of the Earth
20: Where now?

0.6 Recommended texts

Sears and Zemansky’s University Physics with Modern Physics, 12th Edition, Young and Freedman – the recommended text for the core degree course. It has hundreds of problems to work through on the basics of thermodynamics.

Heat and Thermodynamics, Zemansky and Dittman, (McGraw-Hill)

Thermal Physics, Finn (Nelson Thorne)

The Feynman Lecture on Physics, Volume 1: Mainly Mechanics, Radiation and Heat, 2nd Edition (2005), Feynman, Leighton and Sands, Addison Wesley – chapter 39 to 46 contain material relevant to this course, Structure of Matter and Statistical Physics

I will often also provide sources for further reading and inspiration during the course