

Course Guide

1. What the course is about

An important part of physics concerns explaining why matter is the way it is. Matter is made up of atoms, so we can try to understand its properties in terms of the behaviour of its atoms. Translating from atomic-scale behaviour to everyday-scale phenomena is, however, extremely complicated, and this topic occupies several courses throughout the Physics degree programme. *Structure of Matter* is the first of these. It aims to introduce you to some of the crucial ideas and concepts which you will meet again and again in subsequent years.

2. Lectures

There will be 12 lectures, 4 this term, 8 next term. Each lecture will be self-contained, and, after the initial introductory lecture, each has a number and a title. The titles and the dates on which they take place are:

- Introduction to the course (9 March)
- 1. The ideal gas (14 March)
- 2. The first law of thermodynamics (16 March)
- 3. Thermodynamics of gases (17 March)
- 4. The Boltzmann law (5 May)
- 5. Distribution functions (6 May)
- 6. Equipartition of energy (9 May)
- 7. Forces between particles (12 May)
- 8. Non-ideal gases (13 May)
- 9. Properties of fluids (16 May)
- 10. Phase changes (19 May)
- 11. Other states of matter (20 May)

3. Problem sheets and classworks

There will be four problem sheets. Each will contain 8 problems, and will also include a list of the main learning outcomes from the previous few lectures. It is important to realise that some of the learning outcomes might include items from the problem sheets as well as the lectures. There will also be four classworks. The titles and dates of the classworks are:

- I. Hot air balloons (5 May)
- II. The isothermal atmosphere (10 May)
- III. Derivation of the ideal gas equation of state (12 May)
- IV. Surface tension (19 May)

4. Links with other courses

As mentioned above, *Structure of Matter* is the first of several courses which study the properties of matter. For instance, in the Second Year there are four such courses: *Thermodynamics*, *Statistical Physics*, *Applications of Quantum Mechanics*, and *Electrons in Solids*. All the subsequent courses will build on the basic concepts introduced here, for example, the connection between energy and temperature.

This course assumes you are familiar with material from the First Year *Mechanics* and *Electricity and Magnetism* courses.

5. Abbreviations

I will use many abbreviations in the notes on the board. Some of the less familiar ones are:

ad = adiabatic
coll = collision
EOS = equation of state
eqm = equilibrium
IG = ideal gas
MIG = monatomic ideal gas
mol = molecule or mole
proc = process
QS = quasi-static
TD = thermodynamics
VW = van der Waals
 ∞ 'sml = infinitesimal

6. Books

You don't *need* a text-book for this course, but it is extremely useful and interesting to read around the subject. You can gain a lot from seeing someone else's approach, and books can cover more topics, in greater detail, than the lectures. The material covered in *Structure of Matter* corresponds roughly to Chapters 14–17 in *University Physics* by Young and Freedman (the First Year recommended book). Young and Freedman do rather more thermodynamics, for which you'll have to wait until the Second Year.

As a separate book for the course I recommend: *Properties of Matter*, by B.H. Flowers and E. Mendoza (Wiley).

7. If you have difficulties

Office hours. Mondays and Thursdays, 1–2, in Room 726 Blackett. Please don't hesitate to come and see me.

Email. Feel free to email me (m.coppins@ic.ac.uk) with questions, comments, or suggestions for improving the course.