Mechanics (non-examinable)

About this course

The purpose of this course is to cover — rapidly and lightly — material from A-level (or the equivalent) which is needed for other courses in the Tripos, in particular for the Lent term Dynamics and Relativity course. The lectures will be fairly informal and fairly short.

If you have taken M1, M2 and M3 (or the equivalent), you **need not** attend the course: the material should all be familiar to you, but you **are welcome** to attend if you would like to refresh your memory.

If you have taken M1 and M2 but not M3, nearly all the material will be familiar. However, depending on your examination board, you may not have covered simple harmonic motion and motion in a circle. You might like to attend the lectures that cover those important topics.

Organisation of the course

The course consists of 12 lectures, including a short introductory lecture in the first week. In each lecture, I will cover a single topic according to the lecture plan overleaf. If the topic looks unfamiliar, you should attend the lecture. If you are not sure, you should look at the relevant example sheet or lecture notes on my web site:[1]

www.damtp.cam.ac.uk/user/po242/mechanics.html

I will write notes on the blackboard, which will be a subset of the printed notes, and you can either take your own notes in the lecture or rely on the printed notes.

Examples

A short, relatively straightforward, examples sheet will be provided for each topic covered. They are designed to test fundamental understanding but will not require you to do a great deal of manipulation or perform STEP-like acrobatics. If you have already covered the topic at school, you should have no difficulty with the examples; if you do find difficulty with them, you should attend the relevant lecture.

Resources

Full lecture notes and examples sheets with solutions will appear on my web site (see above) in advance of the relevant lecture.

Appropriate books

- P. J. O'Donnell *Essential Dynamics and Relativity.* CRC Press, 2014 (£39.99 paperback)
- J. Hebborn and J. Littlewood *Mechanics 1, 2 & 3 (Edexel).* Heinemann, 2000 (£12.99 paperback)
- L. Bostock and F. S. Chandler *Applied Mathematics, Vols. 1 & Vol. 2.* ST(P) Ltd., 1986 (out of print)

[1] Dr. Siklos created these notes and I will not deviate from them in any substantial manner. His notes can be found at: **www.damtp.cam.ac.uk/user/stcs/mechanics.html**

Lecture plan

L0 (Thursday 8th October) *Short introductory lecture*

No maths — just an outline of the lectures.

L1 (Tuesday 13th October) *Equilibrium of a single particle*

The vector nature of forces, addition of forces, examples including gravity, tension in a string, normal reaction, friction. Conditions for equilibrium.

L2 (Thursday 15th October) *Equilibrium of a rigid body*

Resultant of several forces, resolving forces, couple, moment of a force. Conditions for equilibrium.

L3 (Tuesday 20th October) *Centre of mass*

Definition and examples of centre of mass of a discrete set of particles in one and three dimensions and of a continuous mass distribution in one dimension.

L4 (Thursday 22nd October) *Kinematics of a single particle*

Position, velocity, speed, acceleration. Constant acceleration in one dimension and in three dimensions.

L5 (Tuesday 27th October) *Kinematics of a single particle (continued)*

Projectile motion in two-dimensions.

L6 (Thursday 29th October) *Newton's Laws*

Newton's laws of motion. Newton's second law applied to a single particle. Examples of pulleys.

L7 (Tuesday 3rd November) *Energy*

Definition of energy and work. Kinetic energy, potential energy of a particle in a uniform gravitational field. Conservation of energy.

L8 (Thursday 5th November) *Momentum and Impulse*

Definition of momentum (as a vector), conservation of momentum, collisions, coefficient of restitution. Impulse; example of oblique impact.

L9 (Tuesday 10th November) *Springs, strings and SHM*

Definition of simple harmonic motion. Elastic springs and strings (Hooke's law). Oscillations of a particle attached to a spring, and of a particle hanging on a string.

L10 (Thursday 12th November) *Motion in a circle*

Derivation of the central acceleration of a particle constrained to move on a circle. Simple pendulum.

L11 (Tuesday 17th November) *Motion in a circle (continued)*

Examples including motion of a particle sliding on a cylinder.