We cover Newtonian mechanics. Basic for many sciences. More importantly – general and basic tools and skills.

Course components: lecture and lab. Recitations are optional, and recommended. Grades: in-class, homework, lab, two midterms and final.

Lecture style: via examples; and interactive (desired). physics + problem solving – immediate, concrete examples be active – I am here for you, not the other way round.

Resources: book; website (notes etc); people. We’ll be talking about the book. It is a big book. Our communication: via the web site. (Some Blackboard.) Office hours; TA’s: labs, office hours . . . talk to us.
The material

- Models, theories, laws in physics ... Newtonian mechanics. (This is as easy as they get.)

- Newton’s Laws, dynamics + kinematics (more later today) Energy, momentum; conservation laws.

- Example: say, a chunk of ice on a roof-top. A realistic study ... a nasty problem! (We’ll see some.) We simplify, we approximate – we model. We always do.

- Newtonian mechanics is a simple, but good tool. With our (211–style) model for the above, we can do it. With reasonable simplifications, we get the basic behavior. This little example contains a lot of our class.

- When you model it like this, it really isn’t so hard. So what is the challenge? (Because, it won’t be easy.)
The Challenge

- In short: need to be able to actually do it. Training.

- Develop the skills, learn the tools and techniques – it is a process. You have to take it, make it yours.

- This will be challenging, to assimilate and understand. It takes practice (= solve problems), a lot of it. A lot.

- This class will be hard; there are no two ways about it. I hope it will be interesting and rewarding too – it can. Please work; and talk to me. We are in this together.

- Btw, the math: algebra; reference frames, vectors, trig; handling of (very simple) systems of equations; algebra; understanding of basic calculus; (... mentioned algebra?)
Problem solving

The most crucial component of this class.

A typical process:

- Know (understand) your physics – problem analysis.

- It becomes a mathematically well formulated problem.

- Understand the math of it – manipulate the equations – solve for what you need. (Don’t forget the physics!)

- Throughout, keep you eyes open for where you’re going. Spot errors, mistakes ... or shortcuts, simplifications.

- This is complex, subtle, rounded – it really is a skill. It takes time and effort to develop it. One of our goals.
Motion of a system, dynamics – how to describe it? Firstly and chiefly, we want: \( \vec{r}(t) \). It is that ‘simple.’

Speaking of dynamics ... generally, Newton’s Laws: The ‘state of motion’ (\( \vec{v} \)) – why would it change? The system wants to be left alone, and cruise along. There have to be causes, to change the state (effect) \( \rightarrow \) concept of force \( \rightarrow \vec{a} \) (“acceleration”).

The big contribution of Newtonian mechanics: a very reasonable (and powerful) system; causality, and order.

Once we have (find) acceleration ... well, we are done. The big, real, problem of dynamics has been solved.

What remains is \textit{kinematics} – to work out the details. Very important to learn well. We start with it.
Imagine we have $x(t)$. Take a derivative, with respect to time:

$$v = \frac{dx}{dt}.$$  

The same way,  

$$a = \frac{dv}{dt}.$$  

But this means that when given $a(t)$ we can integrate it (twice)

$$\int a\, dt \rightarrow v, \quad \text{and then,} \quad \int v\, dt \rightarrow x(t).$$

We now know the position at any point in time,

$$x(t) = x_0 + v_0 t + \frac{1}{2}at^2,$$

and can use it to work out details of the motion.  

In short, this is kinematics.