PHYSICS 2302.1
Mechanics I, Fall 2022

Instructor:	David Clarke	AT 311, 420-5830, david.clarke@smu.ca
Lectures:	LA 179	T, Θ: 4:00–5:15 pm
Office Hours:	AT 311	T, Θ: 10:00 am–1:00 pm
Required text:	Fowles & Cassiday's *Analytical Mechanics* (any edition)	
Course website:	www.ap.smu.ca/~dclarke/PHYS2302	
Curriculum:	www.ap.smu.ca/~dclarke/smuap_curriculum/documents/PHYS2302.pdf	
Hand-outs:	various PDF files made available from the website	
Assignments:	Assigned on Thursdays, due one week later; no late assignments accepted once solutions are posted on-line.	
Assessment:	eight assignments	20%
	two midterms	15% each
	final exam	50%

Outline

Part I: Introduction and Review (Ch. 1 & 2; 6 classes)
- vectors, coordinates
- Newton's laws, free-body diagrams
- separable first order ODEs
- position- and velocity-dependent forces

Part II: Oscillators (Chapter 3; 7 classes)
- second order ODEs, inhomogeneous ODEs
- simple harmonic motion

Midterm I: Tuesday, October 18

- damped harmonic motion
- forced harmonic motion, resonance

Part III: Motion of a particle in 3-D (Chapter 4; 5 classes)
- elements of vector calculus
- Work-Kinetic theorem, conservation of mechanical energy
- constrained motion,
- projectiles, multi-dimensional oscillators, electromagnetic forces

Midterm II: Tuesday, November 22

Part IV: Accelerating reference frames (Chapter 5; 4 classes)
- translational and rotational acceleration
- dynamics in accelerating frames
- effects of Earth's rotation

My version of a "hybrid flipped lecture-style classroom"

The "flipped classroom" has come into vogue in a number of university courses including here at SMU. It's one where the students are expected to do all the necessary reading *before* coming to class (with occasional pop quizzes used to encourage students to do so) so that the first half or 2/3 of each class can be spent in a group discussion on the material of the day. This would include everything from "points of clarification", to exploring more subtle aspects of the lesson and possibly doing a demonstration or even a mini-lab. In any time remaining, the instructor typically leads the students in some problem solving exercises to reinforce the material just learned.

All in an ideal world.

This stands in contrast to the "traditional" lecture style classes in which the instructor delivers new material to the class with little or no expectation that anyone has done any reading beforehand. Such lectures are usually given as instructors write down much of what they say on the board, with students furiously copying things down as the class progresses.

For most of my career, I've been an adherent to the lecture style class, doubting students would do enough of the necessary reading beforehand to make the flipped style work.

The pandemic taught me otherwise.

In designing my on-line classes, it became immediately apparent that the traditional note-taking lecture style class was not an option, and flipping the classes seemed unavoidable. Now, while I found that most students were at least reading my lesson notes, many still did not grasp enough of the material to lead us to a useful group discussion. So, in rather rapid time, I had to develop what I call a "hybrid flipped lecture-style classroom" which seemed to work well enough (according to student feedback) to encourage me to try this in my first face-to-face classes since March, 2020.

So, what to expect?

I have rearranged all my traditional lecture notes into 22 distinct and digestible lessons, each of which include a few tutorial-like problems at the end and are on-line now through the course web page. As with any flipped classroom, my expectation is that you will read each lesson through *before* coming to class. This should take you no more than 20 minutes to do and, even if you don't understand everything you read, persevere and make sure you get through it all; we'll clear up any confusions in class!

What clearly *didn't* work in my first attempt at a flipped classroom was counting on a group discussion to arise spontaneously from students' questions. Often, no one came with any questions at all even though it was (painfully) clear few students actually understood all the material. This, in my experience, is reality, not the "ideal world" painted above.

So, the "hybrid" part of this class is me taking the first 40 minutes, say, of each class talking over the lesson notes. Rather than writing much on the board (save for a few diagrams or an occasional derivation), I'll have the lesson notes on the overhead and walk you through them. I would recommend you have the lesson notes printed out beforehand or, if you have a good PDF editor, you can open up the lesson notes on your laptop. Then, as I say things that for you are "Oh, so *that's* what that means!", you can scribble a note to that effect in the margin. If in my talking points you discover you really missed a point, put up your hand! Stop me! Ask for further clarification! If you were confused by something, sure as shootin' others were too.

In addition to my walking you through the lesson notes, there will, on occasion be a demonstration to show you, or perhaps a website with a particularly useful graphic to help make a point. Then, in any time remaining ($\sim$20 minutes), we'll go through the tutorial problems together.

This works best if you're willing to put in the modicum of preparation going through the lesson notes before class. If you miss doing the reading once or twice, you'll notice the difference in how effective my walking you through the notes will be. Not having read the lesson beforehand will likely mean what I say will be too brief for you to "get it" and only with a previous read-through will my talking points make much sense. If you habitually neglect to do the reading, you'll find you may not even be aware of what you don't understand, and only realise what you don't understand when it's too late; *i.e.*, on the midterms.

So, to make this work, promise yourself you'll read through my lesson notes before each class. The class schedule (also available on the course web site) tells you which lesson is to be discussed on which day, and so there is no excuse for not knowing what the reading is! And I think you'll find, as have previous students according to their feedback, that my lecture and lesson notes are very easy to read: big print, lots of figures, easy-on-the-eye, and with explanations and math often much simpler than the text.

Last point is on tutorials, assignments, and exams. There are eight tutorials, each broken up into smaller parts. Thus, tutorial 1 has four bits, namely 1.1, 1.2, 1.3, and 1.4, each done sequentially in the lessons as indicated on the class schedule. Each tutorial is associated with one assignment in the simplest way: tutorial 1 feeds into assignment 1, tutorial 2 feeds into assignment 2, *etc.* You will notice on the schedule that each assignment is due roughly a week *after* each tutorial has been completed. This is deliberate so that the tutorial problems and their solutions (posted on-line) can help you tackle the corresponding assignment. Similarly, the midterms are only based on material you've already done on your assignments. Lessons feed into tutorials feed into assignments feed into exams; at least that's the plan.

And so with all that, let's get started!

D. Clarke, Aug. 2022