Physics 401 (Classical Mechanics)

Text: Classical Mechanics (JR Taylor) -- -- -- note there are errata at the textbook website,
Supplementary: Marion, Morin, Spiegel, Wells, Symon, Boas (reserved in Undergraduate Library)
Mathematical formulae: Dwight (QA310.D5), Prudnikov (QA308.P7813) (reference shelf in Science Library Annex)

Office hours: (Most) Tuesdays and Thursdays, 10:30-11 (but stop by or email for an appt, if you need it)

Before we start, here is a sure strategy to get the best grade possible -- it never fails:

1. Read the book before class.
2. *Do all the problems from the textbook. If you don't understand the concepts, doing problems will help to clarify them.*
3. *Do problems from other books, too. Morin's book and Schaum's Outlines are particularly helpful resources.*
4. Once you understand the important concepts, think about the mathematical representations and manipulations.
5. Link all of the concepts and mathematical structure from the chapter together to see the big picture.

Although the material is challenging and the pace of the course is fast, my intent is that you all pass with good grades.
So if you feel a little overwhelmed, please ask me or some trusted and knowledgeable source for help.
In my case you have already paid for the help, so make sure to get your money's worth.

All exams: (3-4 problems) open notes (only your own hand-written notes -- no photocopies)
Grades: approximately 20% hw problems and 80% exams
Expected mathematical skills:
(1) second order ordinary differential equations
(2) integral and differential calculus on several variables
(3) Fourier expansions
(4) matrix eigenvalues and eigenvectors
(All will be introduced as needed with no background or reinforcement.)

There will be no credit for late homework -- if the clock says 12:01, it's late.

week of	chapter	topics, main themes covered in lectures	problems due Friday at noon
Jan 12	2 - 4	Review of Conservation Laws and Newtonian methods	(2.14, 3.20, 4.9)
Jan 19	5	Linear oscillators, driven damped systems, phase space	review 1
Jan 26	12	Fourier series, nonlinearity, real pendula, chaos, fractals	springs
Feb 2	7.1 - 7.5	Hamilton's Principle, Lagrangian dynamics, Energy equation	12.23, 25, 34
Feb 9	7.6 - 7.10, (13)	Feynman (YHWH ?), connections to quantum mechanics	homework Lag 1
Feb 11	**2-5, 12**	**Test 1**	

Feb 16	8.1 - 8.5	Central Forces, Reduced mass	homework Lag 2
Feb 23	8.6 - 9.5	Kepler's laws, Rotating reference frames	homework Orbits
Mar 1	9.6 - 10	Noninertial frams, ``Fictitious" forces, Foucault's pendulum	homework Noninertial
Mar 8	10.1 - 4	Rigid Rotations, Inertia tensor, Principal moments	homework Rot 1
Mar 10	**7 - 9**	**Test 2**	
Mar 15	----------	**Spring Break (go find cherry blossoms)**	
Mar 22	10.5 - 10	Euler's equations, Free rotation of a symmetrical top	homework Rot 2
Mar 29	11.1 - 4	Coupled oscillators, Normal modes	homework modes 1
Apr 5	11.5 - 7	Normal coördinates, Weighted strings	homework modes 2
Apr 12	16.1 - 3	Continuous systems, Waves on strings	this week's problems,
Apr 19	16.4	Classical field theory and Heisenberg's principle	more wave problems
Apr 26	--	Review, Continuous systems, etc	
Apr 29	**Final Exam, 12pm**		

Here are a couple of math tutorials:
Tutorials on several topics, Tutorial on Tensors, MatLab intensive lecture notes

Other "books" from the web that you might find useful:
Kupferman's lecture notes,
Arovas's lecture notes,

Here are a bunch of little games for you to play with:
various mechanical systems, Cute Fourier synthesizer, interactive fourier transformer , PhET java applet to demonstrate wave packets toy, cute wave tutorials,
Fourier Transform of waves and noise (used in class). Check around under "More applets" for other relevant simulations.

Articles about fractals and randomness in the world:
"Random Fractals: Self -affinity in noise, music, mountains and clouds," Physica **D38** (1989) 362-371 (whole volume on fractal stuff)
"Random fractal Forgeries" in *Science and Uncertainty,* ed Sara Nash (Science Reviews Ltd, 1985).

Books about fractals in nature:
Fractals, chaos, power laws : minutes from an infinite paradise / Manfred Schroeder.

There is a (stolen) simulator for a driven pendulum for anyone who wants to play with it. It's flexible, but slow.
and a "textbook" on chaos

For those who can be discrete, here are the pages from Baierlein's book on the relationship between the Lagrangian and quantum mechanics.

A parable about solving physics problems: It is a creative activity at its best, not a rote process of following instructions

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