

Phys 141-A, Fall 2018

Course Syllabus and Provisional Schedule

House Rules:

1. No prior math is assumed beyond single-variable calculus and HS algebra;
2. You **must** take good notes for each lecture;
3. You **must** form a study group and do problem sets with the group every week (I can help - please see me)..
4. You really **ought to** take advantage of the TAs and myself if you have questions or doubts;
5. No email, please (except correcting mistakes on problem sets).But you can phone (basically) anytime.

Week 1: Oct. 1 - 5 (Mon-Fri)

Basics: Taking Notes, Working in Groups, Working with TA's and faculty

Math Methods: Scalars, Vectors, Scalar Product, Indices, Matrices, Matrix Multiplication, Operators, Rotations (aka Linear Algebra)

Topics:

Motivation for working in the native language of Physics, Mathematics, rather than in (a tourist's) translation

Classical Mechanics as the limiting case of 2 theories: QM and SR

The Einstein Gedanken Experiments

Principle of Special Relativity

Newton's First Law: Frames of Reference, Inertial Frames (assign "Why?")

Space and Time; Events, 4-Vectors, Lorentz Transformations, Natural Units

Invariants

Kinematic problems: (Pole and Barn, Simultaneity, Twin Paradox)

Uncertainty Analysis – assigned reading and on problem set.

The untaught skill of 'Unpacking' problems.

LAB: none

Week 2: October 8 - 12 (Mon-Fri)

Math Methods: Invariants, Lorentz Transformations

Topics:

Setting up and solving simple conservation problems

Energy and momentum: the energy/momentum 4-vector
Invariance of $|p_\mu|^2$; Invariance under Translations and Conservation of E and \vec{p}
E/p problems (Red Shift derivation, Higgs decay, GZK)
(Error Analysis on problem set)
Collisions
Rockets (assign several problems)

LAB: none

Week 3: October 15 - 19 (Mon-Fri)

Math Methods: Solving vector Problems: Components; Taylor/MacLauren Expansion;

Topics:

The NR limit: Newton's 2nd Law;

Free-Body Diagrams

SHM as an example of Newton's 2nd Law

LAB: Contest for most precise measurement of g (first session)

Week 4: October 22 - 26 (Mon-Fri)

Math Methods: Gradient, Line Integrals, Taylor Expansion

Topics:

Work, Energy, Potential

Where is the gravitational potential energy?

Expanding the potential around equilib: SHM

LAB: Contest for most precise measurement of g (second session).

Week 5: October 29 - November 2 (Mon-Fri)

Math Methods: Gradient, Divergence, Curl, Divergence Theorem (Gauss), Stokes Theorem

Physical Interpretations of Gradient, Divergence, Curl

Topics:

Conservative Forces

Non-conservative Forces: Friction

LAB: Explosions and Collisions

Week 6: November 5 - November 9 (Mon-Fri)

Math Methods: Tensors, Matrices, Indices, Einstein Notation

Topics: Angular Momentum, Torque

LAB: Spinning Astronauts

MIDTERM EXAM: TBD: in Discussion Session

Week 7: November 12 - 16 (Mon-Fri)

Math Methods: Multiple Integrals, Tensors, Cylindrical and Spherical Coordinates

Topics:

Rigid Body Motion

Volume Elements in Cylindrical and Spherical Coordinates

Moments of Inertia, the Inertia Tensor

LAB: Moments of Inertia

Week 8: November 19 - 21 (Mon-Wed- No class Friday)

Math Methods: Introduction to solving PDE's

Topics:

Central force motion: Kepler's Laws

Solar System

No Discussion Session Wednesday November 21th

No Lecture Friday November 23th

LAB: none

Week 9: November 26- November 30

Math Methods: Even More Introduction to solving PDE's

Topics:

Ellipses

Central force motion: full solution

LAB: Mechanical Resonance. **PLEASE read the manual beforehand- this is new material, and hence this lab will require more preparation than all other labs. You should be able to handle the mathematics- if not, seek TA or HJF for help.**

Week 10: December 3- December 5 (No class Friday)

No Lecture Friday Dec. 7 (Reading Period)

Review by Solving Problems

(don't forget topics we relied mostly on reading - e.g. rockets,..)

LAB: none

Reading Period Thurs-Fri Dec.6-7

There will be review sessions this week.

**Final Exam: 10:30am - 12:30pm, Friday Dec. 14; KTPC
120**