Course Syllabus ID: 119564
AP Physics C-Mechanics

Textbook: *Fundamentals of Physics*, *Halliday, Resnick*, and Walker; 6th ed. New York: John Wiley Vols. 1 and 2

Class Schedule: Classes meet daily for 47 minutes with an additional 47 minute lab period scheduled every fourth day.

Mid Term and Final Exams are averaged together to make a fifth quarter that is averaged with the four quarters to determine the final grade. Each term exam is a teacher generated "mock" AP exam composed of 35 MC and 3 FR. The exams are scored in the same way that an actual AP test would be scored.

Course requirements: Since this is a calculus-based physics course, students are required to take Calculus AB concurrently as a minimum requisite. However, many students have already had Calculus AB upon entering the course and take Calculus BC concurrently. Students are expected to solve problems with a high degree of complexity consistent with a university-level mechanics syllabus. Also, students are expected to perform a comprehensive sequence of laboratory investigations. All labs are guided inquiry based and require the students to form a hypothesis, determine variables, acquire data, analyze the data, and support a position based on their data. A written Lab report must be submitted upon completion. Students are encouraged to maintain their lab work as evidence for university credit.

Labs Performed

L1) Statistical analysis of data: Least squares principle, Error analysis: *Students learn how to analyze data.*
L2) Interpolating V_{inst} graphically using the air track (vertical intercept on V_{ave} vs. Δt): *Students determine V_{inst} by letting Δt go to zero graphically*.

L3) Galileo's experiment. (g interpolated graphically using data from increasing angles)

L4) Determining acceleration of a glider on the air track. (graphically using V^2 vs. ΔS)

L5) Projectile motion: V_0 determined graphically: *Once the ramp is calibrated, the students use their experimentally determined V_0 to predict the impact point of a horizontally launched projectile.*
L6) Determining an unknown mass using the intertial balance. (T vs. m) *The students calibrate an inertial balance and then use their graphs to determine the mass of an unknown.*

L7) Inclined plane: analysis of carts both in equilibrium and accelerating. *The students must set-up proposed scenarios using the lab equipment provided.*

Labs Performed, Continued

L8) Atwood machine (Ideal Pulley) w/o friction. (*Students discover constant velocity and rest have the same conditions.)*
L9) Centripetal Force analysis using Pasco equipment. (*The mass of the circulating bob is experimentally determined).*

L10) Conservation of energy on the air track. (*After completion of the experiment the students are asked to predict the mechanical energy graphs for a glider experiencing marked amounts of friction).*
L11) Projectile motion: V_0 determined from conservation of energy. (*The students must predict the range of a brass bearing using the law of conservation of energy.)*

L12) Elastic and Inelastic collisions on the air track, including spring driven explosions. (*Conservation laws are studied and challenged).*

L13) Torques in equilibrium. (*Students discover the conditions for equilibrium. They then must determine the mass of a meter stick by balancing torques.)*

L14) Atwood machine, rotational inertia considered. (*Students experimentally determine the moment of inertia for a pulley.)*

L15) Angular momentum conservation in collisions using Pasco rotational apparatus. (*Conservation laws are studied and challenged.)*

L16) Pendulum (g determined graphically using T^2 vs. l)

L 17) Mass-Spring oscillator (*k is determined using T^2 vs. m*)

Syllabus Topics and Related Practice

***** Indicates where calculus is used extensively.

Topics	Chapters in Text	# Weeks Approx.	Problems in HRW and Other Related Practice
SI units, Dimensional Analysis, Scalars, Vectors, Vector Algebra	1,3	1	Various teacher generated problems as well as: Chpt.3 P: 2,5,10,13,14
Kinematics in 1 dimension Constant acceleration model Freefall Inferential graphical analysis of motion * Time varying acceleration *	2	1	Various teacher generated problems as well as: Chpt.2 Q: 1,3,5,7,9 Chpt.2 P: 1,7,10,14-23,27-30,35,36,43-47,52,56,63
Kinematics in 2 dimensions Independence of Vectors Projectiles Range maximization * Unit Vectors Uniform Circular Motion Derivation of centripetal acceleration from the position vector in unit vector form. * Relative motion	4	2	Various teacher generated problems as well as: Chpt.4 Q: 3,7 Chpt.4 P: 17,20,23,25,26,28,29,33,40,42-51,57
Topics	**Chapters in Text**	**# Weeks Approx.**	**Problems In HRW and Other Related Practice**
Mechanics: Newton' s Laws Mass, Force, Weight as a field force	5,6	2	Various teacher generated problems as well as: Chpt.5 Q: 3,5,9-11

Common Forces Newton's Laws Applications: Constant Force Planes, Ideal Pulleys, Connected masses Frictional Forces and Drag Newton' s Laws Applications: Varying Force* Mechanics of Circular Motion			Chpt.5 P: 9,11,16,30,31,34-36,38,43,44,47,52,55,56 Chpt.6 Q: 5,7 Chpt.6 P: 36-41,43,45,47

Topics	Chapters in Text	# Weeks Approx.	Problems In HRW and Other Related Practice
Work, Energy, and Power Graphical Relation of Work* Work calculations: Varying Force* Derivation of Kinetic Energy* (work-energy theorem) Work done by conservative and non conservative forces Potential Energy Curves Potential energies (gravitational and elastic) Conservation of Mechanical Energies Energy dissipated by non-conservative forces Power as the rate of energy transfer*	7,8	2	Various teacher generated problems as well as: Chpt.7 Q: 4,5,6,7 Chpt.7 P: 2,4-7,11,13,17,21-24,28,30,37 Chpt.8 Q: 1,5,9 Chpt.8 P: 3,4,6,16,19,20,21,23-27,32,36-38
Impulse and Momentum Impulse: Time Varying Force* Impulse Momentum Theorem* Center of Mass* Impulse and the Second Law* System Defined Law of Conservation of Momentum Conservation and the Third Law Varying Mass and the Rocket eqns* Elastic and Inelastic Collisions in 1-D and 2-D	9,10	2	Various teacher generated problems as well as: Chpt.9 Q: 3 Chpt.9 P: 2,4,12,19,22-24,26,29-31,40-42 Chpt.10 Q: 8 Chpt.10 Q: 3,6,12-14, 16, 17, 19, 22, 24, 26, 30,31,34,56
Rotational Kinematics Angular Terms Translational and Rotational Connections	11	1	Various teacher generated problems as well as: Chpt.11 Q: 2-11,18-20,26,32,38,40,43 Chpt.11 P: 2,7,11,27,29,33-37,52,55,63,66
Rotational Dynamics Moment of Inertia* Parallel Axis Theorem Pure Rotation: Energy Analysis Pure Rotation: Torque Analysis Rotation/Translation: Energy Analysis Rotation/Translation: Torque Analysis Torque Equilibrium Rotational Variables and Newton's Laws Angular Momentum Conservation of Angular Momentum	12,13	2	Various teacher generated problems as well as: Chpt.12 Q: 1-5,7,16,20,22,24,31,35,39 Chpt.12 P: 4,5,6,8,10,12,15,17,19,21,23,24,26,31,32,33,35, 37,44-46,48,53,59 Chpt.13 P: 9,10,13

Topics	Chapters in Text	# Weeks Approx.	Problems In HRW and Other Related Practice
Gravitation Newton's Law of Gravitation Universal Gravitational Potential Energy Satellites Escape Velocity Planetary Motion Kepler's Laws	14	2	Various teacher generated problems as well as: Chpt.14 Q: 1-4,6,7,11,15,19,37,43 Chpt.14 P: 1,4,5,6,7,8,9,10,15,16,17,19,22,24,26,28,30,39,44,45,48,56,59,61,76,82
Simple harmonic Motion and Oscillations Hooke's Law Revisited Differential Equation Analysis* Kinematics of Oscillations Dynamics of Oscillations The Energy of Oscillations	16	2	Various teacher generated problems as well as: Chpt.16 1,2,6,8,14,18,25,34 Chpt.16 P: 2,8,12,16,18,27,28,32,36,37,39,42,43,49,52,55,60,61

Problem Solving, Student Collaboration and Final Assessments: The students are given opportunities to work collaboratively during regular classroom problem solving sessions. Students will typically work in small groups during these sessions and report their solutions on a whiteboard in the classroom**.**

In addition, a series of culminating activities occur toward the end of the semester, where students are given packets of six problems to solve during that week. The problems are based on released free response questions and provide the students an opportunity work collaboratively in small groups. This also provides the teacher with an opportunity to monitor student understanding. Typically, the students will work together and provide insight on each others strengths and weaknesses. The packets are collected and each set counts as an exam grade. These packet grades are then averaged in with the other independent exam, quiz, and lab grades.