PHYS 310- (Undergraduate) Theoretical Mechanics I (3 credits)
Department of Physics & Astronomy, University of Hawaii
Instructor: Prof. Pui K. Lam
Fall Semester 2019

Time: Tu, Th 9:00 - 10:15 a.m.
Place: WAT 114
Instructor: Prof. Pui K. Lam (956-2988; plam@hawaii.edu)
Office Hours: TBD
Grader: Leah McCabe

Text: "Classical Mechanics" by John R. Taylor, University Science Books.

Pre-req: Pre: 151 or 170 or 170A, and MATH 244 (or concurrent) or MATH 253A (or concurrent); or consent.

Course Outline:

Ch.1 Newton's Law of Motion - (3L)
Ch. 2 Projectiles and Charge Particles (3L)
Ch. 3 Momentum and Angular Momentum (3L)
Review for Midterm 1
Midterm1 (10/1/2019)
Ch. 4 Energy (3L)
Ch. 5 Oscillations (4L)
Ch. 6 Calculus of Variations (3L)
Review for Midterm 2
Midterm 2 (11/12/2019)
Ch. 7 Lagrange Equations (3L)
Ch. 8 Two-Body Central-Force Problems (4L)
Review for Final Exam
Final (12/17/2019, 9:45 a.m. - 11:45 a.m.)

Weekly Quiz (with some exceptions):

Typically on Tuesdays beginning of class (~15 minutes). Two short questions on the topics of previous week and two short questions on reading for current week.
No make up, but you may miss two (actually if you take all of them, then two will be extra credit)

***To participate in the quiz, you need an iclicker remote OR subscribe to "Reef Polling to use with your iphone or Android or computer. There is a subscription fee for Reef Polling; no subscription needed for the iclicker remote . https://www.iclicker.com/*
If you use "Reef Polling" with your phone or computer, you need to create an account with iclicker and search for this course Ph310_F2019 under University of Hawaii Manoa
Please bring your iclicker or have your subscription ready before coming to class on Thursday 8/29/2019.

Homework:

Typically, one homework set per week, 2 to 4 questions per set, and due on Tuesdays.
In principles, doing your homework will help you prepare for the quiz.

Homework assignments will be posted on Laulima. Late homework will be deduce by 20% per day late (excluding weekends)

Homework Answer Format:

In between formulae, there should be narrative explaining what you are doing (pretend you are writing a solution manual). If the grader does not understand what you are doing, the grader cannot give you credits.

Exams:

Midterms:
Take-home portion - 2 long problems (20 pts each)
In-class portion (70 minutes) - 15 short questions (4 pts each)
A sheet of hand-written note (8.5" x 11") is allowed.

Final Exam.
Take-home portion - 2 long problems (20 pts each) – on last two chapters
In-class portion (110 minutes) - 20 short questions (3 pts each) – some questions from previous chapters.
A sheet of hand-written note (8.5" x 11") is allowed.

Course Grade Distribution:

Total (100%) = Homework (20%) + (Midterm 1+ Midterm 2 + Final=(60%)) + Quizzes (20%)

The combined % for Midterm 1+ Midterm 2 + Final=60%; the highest score=25%, middle score=20%, lowest score=15%

Grade Scale: (Based on an absolute scale)

- 96-100 (A+), 91-95 (A), 86-90 (A-)
- 81-85 (B+), 76-80 (B), 71-75 (B-)
- 66-70 (C+), 61-65 (C), 56-60 (C-)
- 51-55 (D+), 46-50 (D), 41-45 (D-)
- <40 (F)
- No "incomplete" (I Grade) will be given.

Student Learning Outcomes:

At the successful completion of this course a student is expected to have:

- An understanding that Newton's Second Law (F=ma) is a differential equation and that most motions do not have constant acceleration, hence we need to solve the differential equation.
- Able to solve analytically a class of problems where F=ma is a linear differential equation with coefficients.
- Able to solve numerically problems where F=ma is a non-linear differential equation.
- A good introduction to an alternative formulation of mechanics called Lagrangian formulation.
- Gain a deeper understanding of conservation laws via the Lagrangian formulation.
- A good introductory understanding of the fundamental difference between non-relativistic and relativistic mechanics

Tentative Course Schedule:

Week	Date	Day	Topics	Sections	Assign	Due
1	8/27	Tu	Diagnostic Exam, Space & Time, Mass & Force	1.1-1.3	HW1	
	8/29	Th	Newton's 1st, 2nd & 3rd Laws	1.4,1.5		
2	9/3	Tu	Quiz1, 2nd Law in Cartesian and Polar coordinates	1.6,1.7	HW2	HW1
	9/5	Th	Linear air resistance	2.1,2.2		
3	9/10	Tu	Quiz2, Linear vs. Quadratic air resistance	2.3,2.4	HW3	HW2
	9/12	Th	Motion of a charge particle in a Uniform B-field	2.5,2.6,2.7		
4	9/17	Tu	Quiz3, Conservation of Momentum, Rockets	3.1,3.2	HW4	HW3
	9/19	Th	Center of Mass, Angular Momentum of a Single Particle	3.3,3.4		
5	9/24	Tu	Quiz4, Total Angular Momentum of Several Particles.	3.5		
	9/26	Th	Review		Mid1-takeho me	HW4
6	10/1	Tu	Midterm 1 – in-class portion		HW5	Mid1-takeho me
	10/3	Th	Work & Kinetic Energy, Conservative force & Potential Energy, Gradient of Potential Energy	4.1,4.2,4.3		
7	10/8	Tu	Quiz5, Energy for Linear 1-D Systems, Curvilinear Systems	4.6,4.7	HW6	HW5
	10/10	Th	Central Force, Energy of Interaction of Two Particles	4.8,4.9		
8	10/15	Tu	Quiz6, Hook's Law, SHM	5.1,5.2	HW7	HW6
	10/17	Th	2-D H.O., Damped H.O.	5.3,5.4		
9	10/22	Tu	Quiz7, Driven H. O., Resonance	5.5,5.6	HW8	HW7
	10/24	Th	Fourier Series, Fourier Series Solution to Driven H.O.	5.7,5.8		
10	10/29	Tu	Quiz8, Calculus of Variations (COV), Euler-Lagrange Equation	6.1,6.2	HW9	HW8
	10/31	Th	Application, COV with Two Variables	6.3,6.4		
11	11/5	Tu	Quiz9, Review for Midterm 2		Mid2 Take-home	HW9
	11/7	Th	Lagrange's Eq. for Unconstrained Motion, Constrained Motion	7.1,7.2	HW10	
12	11/12	Tu	Midterm 2 – in-class portion			Mid2 Take-home
	11/14	Th	Examples of Lagrange's Equations, Generalized Momenta & Ignorable Coordinates.	7.5,7.6		
13	11/19	Tu	Quiz10, Conservation Laws, Lagrange Multipliers & Constraint Forces	7.8,7.10	HW11	HW10

	11/21	Th	Two-Body Central-Force Problems, CM & Relative Coordinates	8.1,8.2		
14	11/26	Tu	Quiz11, Equation of Motion, Equivalent 1-D Problem	8.3,8.4	HW12	HW11
	11/28	Th	Thanksgiving Holiday			
15	12/3	Tu	Quiz12, Equation for Orbits, Bounded Kelper's Orbits	8.5,8.6	HW13	HW12
	12/5	Th	Unbounded Kelpler's Orbits, Changing Oribits	8.7,8.8		
16	12/10	Tu	Quiz13, Review for Final Exam			HW13
	12/12	Th	Review for Final Exam		Final Exam-Take-home	
	12/17	Tu	Final Exam – In-class (9:45 – 11:45 a.m.)			