UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF PHYSICS AND ASTRONOMY
COURSE OUTLINE

1. **Course:** PHYS 341 Classical Mechanics I   Fall 2017

   Instructor: Dr. David Hobill | SB 539 | (403) 220-6965 hobill@ucalgary.ca
   Office Hours: T 10:00-11:30, TR 14:00-15:30

   Lecture Sections: LEC 1 | MWF 16:00-16:50 | ICT 116

   Course Website: d2l.ucalgary.ca

   Departmental Office: SB 605, 403-220-5385, phasugrd@ucalgary.ca

2. **Prerequisites:** PHYS 227 or 321 and MATH 211 or 213; and AMAT 219 or MATH 253 or 267 or 277 or 283.
   Note: The Faculty of Science policy on pre- and co-requisite checking is outlined in the 2017-2018 Calendar. A student may not register in a course unless a grade at least" C-" has been obtained in each pre-requisite course; it is the responsibility of students to ensure that their registrations are in order. See http://www.ucalgary.ca/pubs/calendar/current/sc-3-5.html for details.

3. **Grading:** The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

   Assignments: 25%
   In-Class Tests (2): 30%
   Labs (5): 15%
   Final Examination: 30% (To be scheduled by the Registrar)

   Percentage grades will be given for all elements of term work and examinations. A weighted course percentage will be calculated to the nearest whole number for each student after the final exam is written. A table of conversion from final course percentage to final course letter grade will be published on the course website later in the term.

   Percentage to letter grade conversion scale:

> = 95%	A +	> = 75%	B +	> = 60%	C +	> = 45%	D +
> =85%	A	> = 70%	B	> = 55%	C	> = 40%	D
> =80%	A -	> = 65%	B -	> = 50%	C -	< 40 %	F

4. **Missed Components of Term Work:** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in <u>Section 3.6</u>. It is the student's responsibility to familiarize himself/herself with these regulations. See also <u>Section E.6</u> of the University Calendar.

5. **Scheduled out-of-class activities: None**

   REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME-ACTIVITY. If you have a clash with this out-of-class-time-activity, please inform your instructor as soon as possible so that alternative arrangements may be made for you.

6. **Course Materials:** Analytical Mechanics*, Fowles and Cassiday, 6th Edition, Thompson-Brooks Cole*

   Online Course Components: Additional Lecture notes will be posted on the UCalgary D2L Website

7. **Examination Policy:** Calculators are allowed, but no networked devices. Students should also read the Calendar, <u>Section G</u>, on Examinations.

8. **Approved Mandatory and Optional Course Supplemental Fees**: None

9. **Writing across the curriculum statement:** In this course, the quality of the student's writing in laboratory reports will be a factor in the evaluation of those reports. See also <u>Section E.2</u> of the University Calendar.

10. **Human studies statement:** Students in the course will not be expected to participate as subjects or researchers. See also <u>Section E.5</u> of the University Calendar.

11. **OTHER IMPORTANT INFORMATION FOR STUDENTS:**

    (a) Misconduct: Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under <u>Section K</u>. Student Misconduct to inform yourself of definitions, processes and penalties.

    (b) Assembly Points: In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on <u>assembly points</u>.

    (c) Academic Accommodation Policy: Students needing an Accommodation because of a Disability or medical condition should contact Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities available at <u>http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf.</u> Students needing an Accommodation in relation to their coursework or to fulfill requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the Associate Head of the Department of Physics and Astronomy, Dr. David Feder, by email (dfeder@ucalgary.ca) or by phone (403.220.3638).

    (d) Safewalk: Campus Security will escort individuals day or night (http://www.ucalgary.ca/security/safewalk/). Call 2205333 for assistance. Use any

campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

(e) Freedom of Information and Privacy: This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also http://www.ucalgary.ca/secretariat/privacy.

(f) Student Union Information: VP Academic Phone: 220-3911 Email: suvpaca@ucagary.ca.

(g) SU Faculty Rep: Phone: 220-3913 Email: science1@su.ucalgary.ca, science2@su.ucalgary.ca and science3@su.ucalgary.ca

(h) Student Ombuds Office: 403 220-6420 Email: ombuds@ucalgary.ca; http://ucalgary.ca/provost/students/ombuds

(i) Internet and Electronic Device Information: You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

(j) U.S.R.I.:   At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses (www.ucalgary.ca/usri). Your responses make a difference - please participate in USRI Surveys.

12. **OTHER COURSE RELATED INFORMATION:**

(a) Course Description

Vector algebra and coordinate transformations; Applications of Newton's second law; Forced and damped harmonic oscillations with real and complex numbers; anharmonic oscillators; central force motion and scattering; non-inertial frames; 2- and 3-body problems; applications of linear differential equations and complex numbers.

(b) Course Learning Outcomes

This course (along with PHYS 343) establishes the foundations of classical mechanics as the basis for subsequent physical theories (e.g. statistical mechanics, electromagnetic theory, quantum mechanics, etc.). In particular the students are expected to develop a level of mathematical sophistication that allows them to solve more complex problems with methods that involve clarity of thought, logical argumentation, and the ability to verify the final results and apply them to real world situations. In addition students should be able to:

- understand the relationship between fixed Cartesian coordinate systems and coordinate systems that can change in time.
- present Newton's second law of motion in a form that can be written as a first order ordinary differential equation and using separation of variables integrate the equation of motion.
- understand the importance of position dependent forces: particularly those that are conservative and how they are related to a potential energy function. Using that function they should be able to qualitatively predict the motion of the particle. In addition they should develop a sense of when and where the dynamics is stable and/or unstable.
- understand velocity dependent forces - particularly those associated with dissipative effects
- recognize the equations that describe oscillatory systems and be able to compute the oscillation frequencies, as well as any damping occurring in those systems with and without external driving forces.
- decompose Newtonian dynamical systems into a dynamical system of first order ordinary differential equations, understand how to define a phase space for those systems, compute the equilibrium points and determine their stability.
- recognize the equations that describe central forces, understand the concept of angular momentum for a single particle and understand the meaning of its conservation particularly in the development of and "effective potential" and how that relates to orbits defined by conic sections.
- understand the difference between inertial and non-inertial frames for both linearly accelerated and rotating systems.
  develop familiarity with laboratory methods, techniques and error analysis, particularly those that relate to the theoretical developments presented in the lecture sections.

(c) Course Learning Incomes

Students taking PHYS 341 are expected to have prior knowledge in algebra, trigonometry, integration and differentiation, vector algebra, Newton's second law.

(d) Syllabus

This course will focus on the mechanics of single particles under the presence of external forces, and in particular conservative forces. PHYS 343 will follow with an emphasis on multiple particle interactions and the motion of extended objects.

- Vectors, and vector operations. Taylor series and linear approximations.
- Coordinates and coordinate transformations
- Rectilinear motion of a particle. Conservative forces. Kinetic and potential energy. Velocity-dependent forces: Fluid drag and terminal velocity.
- Newton's Second Law and First order ordinary differential equations
- Oscillations. Harmonic motion, with and without damping. Forced harmonic motion: Resonance.
- Non-linear oscillations and Chaos.
- Perturbation methods
- Central Forces, Orbital motion and Scattering, Effective Potential
- Noninertial reference frames. Accelerating frames. Rotating coordinate systems.

Please note laboratory exercises will begin on Sept 25, 2017 (See the schedule given below). Further information regarding the laboratories will be posted on the D2L website.

(e) Lab Schedule

Week: Sept. 25 "Inclined Atwood Machine"
        Oct. 10 "Drag Forces"
        Oct. 23 "Hanging Chain"
        Nov. 14 "Damped Mechanical Oscillations"
        Nov. 27 "Forced Mechanical Oscillations"

Department
Approval_____Date_____