



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

1. **Course:** PHYS 271 How Things Work Winter 2017

**Instructor:** Dr. David Feder | SB 535 | (403) 220.3638 | [dfeder@ucalgary.ca](mailto:dfeder@ucalgary.ca) | Office Hours: M 11:00-13:00

**Lecture Sections:** LEC 1 | MWF 14:00-14:50 | TI Learning Studios D&E

**Course Website:** [d2l.ucalgary.ca](https://d2l.ucalgary.ca)

**Department Office:** SB 605, 403-220-5385, [phasugrd@ucalgary.ca](mailto:phasugrd@ucalgary.ca)

2. **Prerequisites:** none. However, Credit for [Physics 271](#) and any 200-level Physics course will not be allowed.
3. **Notes:** Some previous exposure to physics, e.g., Science 10, is strongly recommended. Not intended for Physics majors, Natural Science Physics Concentrators, or Environmental Science Physics Concentrators. Will not count in the field of Physics.
4. **Grading:** The University policy on grading and related matters is described in [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: 20%

Quizzes: 30%

Presentations: 30%

Term paper: 20%

Percentage to letter grade conversion scale:

≥ 94 %	A +	≥ 82 %	B +	≥ 70 %	C +	≥ 58 %	D +
≥ 90 %	A	≥ 78 %	B	≥ 66 %	C	≥ 54 %	D
≥ 86 %	A -	≥ 74 %	B -	≥ 62 %	C -	< 54 %	F

**Assignments:**

There will be nine assignments over the course of the term, together constituting 20% of the final grade. Assignments are completed using WileyPLUS. The WileyPLUS system is free to access if you are using a campus computer (for example at the Taylor Digital Library). This will give you no access to the on-line textbook, however. If you wish to also have access to an e-text, then you can purchase WileyPLUS + textbook as a bundle. Instructions for accessing WileyPLUS can be found on the course D2L page. The assignments are all multiple choice. You are expected to work on assignments on your own. You can keep returning to the assignment as long as it is posted, and it will remember your previous responses, which can be changed up until the due date. Assignments will not be accessible after the due date.

**Quizzes:**

At the beginning and end of almost every class, you will answer a short quiz that explores your understanding of one or more concepts to be explored in that class. The mark breakdown for this 30% component is as follows. Pre-quizzes will add to 10% (5% participation and 5% response accuracy), post-quizzes will add to 20% (5% participation, 15% accuracy). The quizzes are all performed using the TopHat classroom response system. You must bring an electronic device (cell phone, smart phone, tablet, laptop computer, etc.) to class in order to take the quizzes. You can also use these devices to display information on the movable electronic screens (carts) in the classroom.

**Group Work:**

You have already been assigned to a group of five students. You can find your group membership information on the D2L page. You will conduct all in-class activities with this group. I have striven to strike a balance of students at different stages of their academic life, and I expect that you will work together with your group members in a respectful and engaging manner. Changing groups is possible, but only with express permission by both parties and by me. Please note that your ability to answer the post-quiz will hinge on how actively you participate in in-class group activities and understand what you are observing.

**Presentations:**

You will be working with a group of four students on two different projects, each worth 15% of the total course grade. The first will cover a special topic for a mechanical system (due in the middle of the term, the deadline to be determined), the second for a thermodynamic, electric, or electronic device (due at the end of term, the deadline to be determined). Each project will consist of analyzing a natural phenomenon or a human-built system, and presenting a description. The topics should be identified early in consultation with the instructor. You can think of the group projects as being effectively in lieu of your midterm and final exams, without the stress! The midterm and final projects will consist of a poster-style presentation. The poster is electronic, presented on one of the monitor carts in the Learning Studio. The poster can therefore include animations. You are also welcome to bring additional props. The posters will be peer-evaluated: your presentations will be evaluated by other students, and likewise you will be evaluating other students' work. Your project grades will be an amalgamation of your peer and instructor assessments. You may choose your group members if you prefer; if you have no preference then I will choose the makeup of your group.

**Term paper:**

The term paper is worth 20% of the final grade. The topic will correspond to the system presented in the second (final) poster presentation. As this is a group-work term paper, students are responsible for dividing the work among the team members. One suggestion is that each student takes ownership of a particular section. This paper should take the form of a scientific paper. Pay attention to sentence structure, grammar, and spelling; this is your opportunity to express yourself clearly. Marks will be deducted for writing errors, so proofread your paper carefully (or have a friend help you!). Bonus marks for humour and creativity!

The cumulative grade for the course will be determined by adding the numerical grades for the five components and then converted to a letter grade according to conversion table above.

5. **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 University Calendar in [3.6](#). Each student is responsible for becoming familiar with these regulations. See also [E.6](#) of the Calendar.
6. **Scheduled out-of-class activities:** Not applicable.
7. **Course Materials:** *How Things Work*, 5<sup>th</sup> or 6<sup>th</sup> Ed., Louis A. Bloomfield (Wiley)
8. **Examination Policy:** None.
9. **Approved Mandatory and Optional Course Supplemental Fees:** None

10. **Writing across the curriculum statement:** In this course, the quality of the student's written project and clarity in the presentation of assignments will be factors in the evaluation of these tasks. See also [E.2](#) of the University Calendar.
11. **Human studies statement:** Students in the course will not be expected to participate as subjects or researchers. See also [E.5](#) of the University Calendar.

12. **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 [K](#). 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 [assembly points](#).
- (c) **Student Accommodations:** 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 [http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities\\_0.pdf](http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf). 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](mailto: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 220-5333 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 (FOIPPA). 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@ucalgary.ca](mailto:suvpaca@ucalgary.ca).  
SU Faculty Rep: Phone: 220-3913  
Email: [science1@su.ucalgary.ca](mailto:science1@su.ucalgary.ca), [science2@su.ucalgary.ca](mailto:science2@su.ucalgary.ca) and [science3@su.ucalgary.ca](mailto:science3@su.ucalgary.ca)  
Student Ombuds Office: 403 220-6420  
Email: [ombuds@ucalgary.ca](mailto:ombuds@ucalgary.ca); <http://ucalgary.ca/provost/students/ombuds>
- (g) **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 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.
- (h) **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](http://www.ucalgary.ca/usri)). Your responses make a difference - please participate in USRI Surveys.

## 12. OTHER COURSE RELATED INFORMATION:

### (a) Course Description

Physics behind many common devices will be discussed. Topics will be chosen from among the following: the use of simple and compound machines; waves, sound, acoustics; light and optics; household electric circuitry; magnetism.

### (b) Course structure

This course is being offered in a completely 'flipped' style. There are no traditional lectures. Class time is devoted to taking quizzes, engaging in activities, participating in discussions, undergoing group work, taking and analyzing data, etc. You are expected to study the underlying theoretical concepts outside of class time by reading the textbook and answering the questions of the on-line homework. You must keep up with your studies or you will jeopardize your success on the in-class quizzes, which are worth 30% of your total grade.

### (c) Course Learning Outcomes

The main point of this course is to give you the physics-based tools to understand the natural and human-made world around us. With these tools, you will be able to interpret and explain many natural phenomena and to deconstruct and describe the fundamental mechanisms for many modern (and not so modern) devices and technologies. The focus is on conceptual understanding; very little mathematical ability is required or expected (other than simple arithmetic). The topics to be covered range from mechanical systems (including those that have some kind of power source), through electrical/electronic and light-based technologies, with some time devoted to music in between. While the course can be considered somewhat as a brief survey of physics for the non-physics student, the real motivation for the content is to convey the ideas that physicists need to make sense of the world around us. In the process, we'll uncover a few bizarre theories that I believe will surprise and intrigue you.

### (d) Syllabus

#### I. Chapter 1: The Laws of Motion, Part 1

##### Key Concepts:

- i. Inertia
- ii. direction of motion, velocity, acceleration
- iii. uniform and non-uniform motion
- iv. velocity in rotational motion
- v. Newton's 2nd law: force and acceleration
- vi. gravitational acceleration
- vii. Newton's 3rd law: action and reaction forces
- viii. kinetic energy and potential energy
- ix. work and its relation to force
- x. terminal velocity

Applications: skating, falling objects, ramps, pulleys, projectiles

#### II. Chapter 2: The Laws of Motion, Part 2

##### Key Concepts:

- i. center of mass
- ii. torque
- iii. rotational motion
- iv. rotational mass
- v. moment of inertia
- vi. friction: static, kinetic, and rotational
- vii. energy
- viii. thermal energy
- ix. momentum and its relation to force

- x. angular momentum
- xi. conservation laws

Applications: seesaws (teeter-totters), balance scales, levers (i.e. crowbars), wind/water mills, pliers, tires, bumper cars

### III. Chapter 3: Mechanical Objects, Part 1

#### Key Concepts:

- i. Springs
- ii. Elastic collisions
- iii. Inelastic collisions
- iv. Impulse
- v. Relative velocity
- vi. Apparent weight
- vii. Rotational motion

Applications: spring scales, running shoes, bouncing balls, elevators, amusement rides, salad spinner, snowboarding (half-pipe)

### IV. Chapter 4: Mechanical Objects, Part 2

#### Key Concepts:

- i. Torque
- ii. Static / dynamic equilibrium
- iii. Stable / unstable equilibrium
- iv. Celestial bodies: moon, earth
- v. Escape velocity

Applications: bicycles, hears, tides, rockets and space travel, satellites

### V. Chapter 7: Heat and Phase Transitions

#### Key Concepts:

- i. Heat
- ii. Temperature
- iii. Thermal conductivity
- iv. Convection
- v. Radiation
- vi. Sublimation
- vii. Evaporation
- viii. Phase transitions
- ix. Blackbody absorption / radiation
- x. Thermal expansion / contraction

Applications: thermometers, cooking, construction, ocean and air currents, global warming, clothing, insulation, clothes, phases of water

### VI. Chapter 8: Thermodynamics

#### Key Concepts:

- i. Entropy and relation to heat
- ii. Thermodynamic equilibrium
- iii. 0<sup>th</sup> Law of thermodynamics: spontaneous flow of heat
- iv. 1<sup>st</sup> Law of thermodynamics: conservation of energy
- v. 2<sup>nd</sup> Law of thermodynamics: entropy always increases toward equilibrium
- vi. 3<sup>rd</sup> law of thermodynamics: entropy minimum at zero temperature

Applications: engines, automobiles, refrigerators, air conditioners, furnaces, heat pumps

### VII. Chapter 9: Resonance and Mechanical Waves

#### Key Concepts:

- i. Pendulums
- ii. Harmonic motion
- iii. Strings: tension
- iv. Waves and vibrations
- v. Stationary and traveling waves
- vi. Longitudinal and transverse waves
- vii. Sound
- viii. Nodes and antinodes
- ix. Interference
- x. Resonance
- xi. Frequency and wavelength
- xii. Material properties
- xiii. Reflection and refraction

Applications: clocks, musical instruments, earthquakes, water waves

#### VIII. Chapter 12: Electromagnetic Waves

##### Key Concepts:

- i. Electric and magnetic fields
- ii. Electromagnetic waves
- iii. Spectrum of light
- iv. Frequency and wavelength
- v. Radio: AM and FM
- vi. polarization

Applications: antennae, electronics, radios, microwave ovens

#### IX. Chapter 13: Light

##### Key Concepts:

- i. Molecular absorption and emission of light
- ii. Quantum transitions
- iii. Light scattering
- iv. Reflection and refraction
- v. Interference
- vi. Polarization
- vii. Color: additive
- viii. Color: subtractive
- ix. Fluorescence
- x. Coherent and incoherent light
- xi. lasers

Applications: sunlight, why is the sky blue, why are sunsets red, oil slicks, different kinds of lights, LEDs, lasers

**(e) Lab Schedule:** Not Applicable

Department Approval \_\_\_\_\_ Date \_\_\_\_\_