

UNIVERSITY OF CALGARY
DEPARTMENT OF PHYSICS AND ASTRONOMY
COURSE OUTLINE

1. **Course:** Physics 271, How Things Work

Lecture Sections:

L01: MWF, 1300-1350, ST 130

L02: TR, 1400-1515, ST 057

Instructor: David Feder, (403) 220-3638, dfeder@ucalgary.ca

Office Hours: Wednesdays, 1400-1600

Course website: d2l.ucalgary.ca (<https://d2l.ucalgary.ca/d2l/home/83043>)

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

2. **Prerequisites:** none

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:	44%
Previews:	14%
Group Work:	40%
Surveys:	2%
<hr/>	
Total:	100%

Conversion from final course percentage to final course letter grade is as follows:

94+	A+
90+	A
86+	A-
82+	B+
78+	B
74+	B-
70+	C+
66+	C
62+	C-
58+	D+
54+	D
54-	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 **Section 3.6**. It is the student's responsibility to familiarize himself/herself with these regulations. **Section E.6** of the University Calendar.

5. **Course Materials:** *How Things Work, 5th Edition* by Louis A. Bloomfield (Wiley, 2013)

6. OTHER IMPORTANT INFORMATION FOR STUDENTS

- (a) 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 [Section 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) Academic Accommodation Policy: Students with documentable disabilities are referred to the following links: Calendar entry on [Students with Disabilities](#) and [Student Accessibility Services](#).
- (d) Safewalk: Campus Security will escort individuals day or night: [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 (FOIP). 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 [University Legal Services - FOIP](#).
- (f) Student Union Information: VP Academic Phone: 220-3911 Email: suvpaca@ucalgary.ca. SU Faculty Rep. Phone: 220-3913 Email: sciencerep@su.ucalgary.ca Student Ombudsman Phone: 220-6420 Email: ombuds@ucalgary.ca.
- (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 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.
- (h) USRIs: 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. Your responses make a difference - please participate in USRI Surveys.

Departmental Approval

Date

Associate Deans Approval
for alternate final examination arrangements

Date

COURSE SYLLABUS

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

Key concepts:

- inertia
- direction of motion, velocity, acceleration
- uniform and non-uniform motion
- velocity in rotational motion
- Newton's 2nd law: force and acceleration
- gravitational acceleration
- Newton's 3rd law: action and reaction forces
- kinetic energy and potential energy
- work and its relation to force
- terminal velocity

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

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

Key concepts:

- center of mass
- torque
- rotational motion
- rotational mass
- moment of inertia
- friction: static, kinetic, and rotational
- energy
- thermal energy
- momentum and its relation to force
- angular momentum
- conservation laws

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

3. Chapter 3: Mechanical Objects, Part 1

Key concepts:

- springs
- elastic collisions
- inelastic collisions
- impulse
- relative velocity
- apparent weight
- rotational motion

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

4. Chapter 4: Mechanical Objects, Part 2

Key concepts:

- torque
- static / dynamics equilibrium
- stable / unstable equilibrium
- celestial bodies: moon, earth
- escape velocity

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

5. Chapter 7: Heat and Phase Transitions

Key concepts:

- heat
- temperature
- thermal conductivity
- convection
- radiation
- sublimation
- evaporation
- phase transitions
- blackbody absorption / radiation
- thermal expansion / contraction

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

6. Chapter 8: Thermodynamics

Key concepts:

- entropy and relation to heat
- thermodynamic equilibrium
- 0th law of thermodynamics: spontaneous flow of heat
- 1st law of thermodynamics: conservation of energy
- 2nd law of thermodynamics: entropy always increases toward equilibrium
- 3rd law of thermodynamics: entropy minimum at zero temperature

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

7. Chapter 9: Resonance and Mechanical Waves

Key concepts:

- pendulums
- harmonic motion
- strings: tension
- waves and vibrations
- stationary and traveling waves
- longitudinal and transverse waves
- sound
- nodes and antinodes
- interference
- resonance
- frequency and wavelength
- material properties
- reflection and refraction

Applications: clocks, musical instruments, earthquakes, water waves

8. Chapter 12: Electromagnetic Waves

Key concepts:

- resistors, conductors, capacitors, and inductors
- electrical circuits
- electric and magnetic fields
- tank circuits
- electromagnetic waves
- spectrum of light
- accelerating charges
- frequency and wavelength
- radio: AM, FM
- polarization

Applications: antennae, electronics, radios, microwave ovens

9. Chapter 13: Light

Key concepts:

- molecular absorption and emission of light
- quantum transitions
- light scattering
- reflection and refraction
- interference
- polarization
- color: additive
- color: subtractive
- fluorescence
- coherent and incoherent light
- lasers

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

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**; no mathematical ability is required or expected. 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.

ASSIGNMENTS (WileyPLUS)

Assignments can be found at the ‘Assignments’ link in the main Content area on the D2L course website. Assignments are completed using WileyPLUS. The first time you access this page, you will be asked to accept the WileyPLUS license, which will be free for your use. The assignments are all multiple choice. 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 be inaccessible after the due date.

You can keep track of your assignment grades by clicking on ‘Assignment Grades’ in the ‘Assignments’ section of the Contents in D2L. Also, your assignment grades should be transferred automatically to the ‘Grades’ section of D2L (which can be found by clicking on the ‘Assessments’ tab).

PREVIEWS

Each week, you will be expected to preview important material to be covered the following week. The emphasis is on understanding rather than on technical details. The reviews are to be submitted by the beginning of the first lecture of each week, and no late reviews will be accepted. Previews are to be uploaded to the Previews area of the D2L Dropbox, which can be accessed from the ‘Assignments’ tab in D2L (not brought to class).

Previews can be completed in two ways:

- The intellectual way: These will summarize, in written form, the main concept or concepts to be covered in the next week. Previews must be at most one page (single-sided). Often a paragraph or two is sufficient. For those technically inclined please take note: mathematics should be avoided unless absolutely required. Pay attention to sentence structure, grammar, and spelling; this is your opportunity to express yourself clearly. **Marks will be deducted for unnecessary use of mathematics, for previews over the length limit, and for writing errors.** Bonus marks for humour and insight.
- The creative way: You produce a creative piece that effectively conveys the main concept or concepts to be covered in the next week. The format is up to you; examples of formats I have received in previous years (this is not exhaustive) include cartoons, poems, song lyrics, recorded songs or music, short movies, sculptures, and knitting. Because you might be communicating concepts in an oblique manner, you have some artistic license. I will keep this in mind when evaluating the submission; however, keep in mind that I am looking for a clear and *accurate* portrayal of the subject matter. Keep any submission that requires playback (i.e. recordings and movies) to two minutes or under.

GROUP WORK

You have already been assigned to a group of four students. You can find your group membership information on the course D2L page. You will be working with this group on two different projects. 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 (either existing or something of your own invention), and presenting a description. You can think of the group projects as being effectively in lieu of your midterm and final exams, without the stress!

Group project reports will be submitted to a common-access area of D2L (to be determined), and will be evaluated by your peers. Likewise, you are required to evaluate at least three other group projects. Your project grades will be an amalgamation of your peer assessments and my assessment.

SURVEYS

There will be no traditional lectures in this course. Instead, class time will be spent performing experiments, having discussions, and doing various kinds of activities. I would appreciate knowing your feelings about these classroom activities soon after you experience them. You are therefore encouraged to fill out a short weekly survey, which can be found by clicking on 'Surveys' under the 'Assessments' tab of D2L. Survey results sent to me are completely anonymous; I am only interested in the aggregate results and your comments, not in who is sending them. That said, D2L knows who has participated in the survey, and they are worth 2% of your total grade as an incentive. Surveys will be available at 3:00pm on Fridays, and disappear at 11:30pm the following Monday. See the Calendar in D2L for the schedule.