PHYSICS 140–141
INTRODUCTION
Philosophy, Policies and Procedures

PHYSICS: FROM THE PRACTICAL TO THE PROFOUND

Physics is a science which attempts to unify elements of the natural world by means of observation, mathematics, and the use of precise language. Using methods developed by physicists, we can describe many events that occur in our everyday lives. The principles of physics provided a basis for most of the technologies that are an essential part of modern life. In this sense, physics is *practical*. Many laws developed by physicists, such as the law of conservation of energy, are of tremendous practical importance. These same laws also help physicists understand the very tiny constituents of matter as well as the motions of giant clusters of galaxies. Thus the study of physics helps us understand some fundamental relationships between the matter in our surroundings and the evolution of the universe. In this sense physics is *profound*. You are about to begin your own exploration of the natural world using some of the concepts, tools, and methods commonly employed by physical scientists. Thus, you are beginning what we hope will become a grand journey from the practical to the profound that will continue long after you have completed introductory physics.

THE WORKSHOP PHYSICS PHILOSOPHY

In traditional science courses, attending lectures, reading a textbook, and solving problems are the primary learning activities. These activities are usually supplemented by a weekly laboratory session taught by an instructor other than the lecturer. The emphasis in traditional courses is on *what* you know.

Physics is fundamentally an experimental science. The theories, laws, and mathematical descriptions of the physical universe that have been created during the past 3000 years are based on the experience and observations of our ancestors. In Workshop Physics, the lecture and laboratory elements of the course are integrated so that your understanding of physics is enhanced by class discussions, personal reflections, observations, and experiments. Your ability to perform observations, take data, analyse results, and write reports will be enhanced by the use of a personal computer. The computer, when equipped with sensors and software, can be used for data collection and display, mathematical calculations, graphing, drawing, the simulation of physical events, mathematical modelling, and word processing.

The use of direct experience, new computer tools, and active participation will enable you to achieve an enriched set of learning goals. In addition to beginning to master an impor-

tant body of knowledge and learning how to solve traditional physics problems, you should be able to develop your reasoning ability and computer and laboratory skills to a much greater extent than you would in ordinary introductory physics courses. In fact, in Workshop Physics your powers of observation, reasoning ability, and the depth of comprehension of physical theories are considered to be far more important than any memorized facts, theories, or laboratory procedures. The critical question in this course is not "What do you know" but rather "*How* do you know what you know?"

INSTRUCTORS

140: Neil Alberding, Karen Kavanagh
141: Sarah Johnson

OFFICE HOURS

The Physics Studio room will be open for an extra hour, to be arranged, on Monday, Wednesday and Friday. You can come in and preview the equipment or ask questions then.

STUDENT ASSISTANTS

Each section of the course will have one or two student teaching assistants (known as TA's) who have already completed introductory physics. Student assistants will be available to help you during class sessions and during scheduled evening hours.

PHYSICS STUDIO HOURS:

Access to the Physics Studio may be possible outside class hours by prior arrangement.

REQUIRED MATERIALS:

You should purchase for the course

2. The Text for the Course: *Understanding Physics,* Cummings et al.
3. A clear plastic ruler (with a centimetre scale)
4. A clear plastic protractor.

Recommended –
5. A scientific calculator

BEFORE AND DURING CLASS — WHAT'S EXPECTED:
An Activity Guide has been developed to support the Workshop Physics approach to learning. In-class written work will consist primarily of documenting your class activities by filling in the entries in the "activity" spaces provided. You are encouraged to keep your

own notes in the margins of the Activity Guide. *You should not make a practice of waiting until after class to fill in your guide.*

Before coming to each class session, you should have completed the Activity Guide entries from the previous class session (hopefully in the previous class) and done the assigned reading from the text or other documents. You should also have completed the assigned homework.

During class sessions, your willingness to discuss ideas with classmates, devise clever ways to measure or observe things, and make brief presentations using the board at the front of the classroom are important aspects of your participation in the course. *You are expected to be participating actively in the class sessions at all times.*

The use of the computer during scheduled class periods is restricted to course related activities. In particular, computer games may be hazardous to your mental health and detrimental to your class participation and other grades.

WRITTEN AND ORAL WORK

Activity Guide Entries

Activity Guide entries describe observations, derivations, calculations, and answers to questions. In the guide, the bold word **Activity** followed by a pair of numbers signifying the unit and activity number (e.g. **Activity 1-2**) indicates that a series of entries using *data, words , sketches, or graphs* is requested. Although you may use the same data and graphs as your partner(s) and discuss concepts with your classmates, all entries should reflect *your own understanding* of the concepts and the meaning of the data and graphs you are presenting. *Thus each Activity Guide entry must be written in your own words. Students who copy Activity Guide entries from current or old Guides will be reported for plagiarism.*

The pages containing the entries for each Unit are due at the beginning of the next class period after the Unit work is completed.

All of your Activity Guide units will be examined for completeness. In addition, several of your Units will be chosen at random to be carefully evaluated by one of the course instructors and given a percentage grade for quality and completeness. Instructors will look for complete sentences, clear expository writing, proper labelling of graphs and tables, the use of appropriate units with numbers, accuracy of calculations, the expression of results to the correct number of significant figures, and adherence to instructions. *It is ultimately your responsibility to see that your entries reflect a sound understanding of the phenomena you are observing and analysing.* Since these Activity Guide entries will be open to you when you take examinations, *it is to your advantage to create a set of entries and marginal notes based on in-class discussions and text book readings that are useful references as you complete examinations.*

At the end of the semester your Activity Guide scores will be translated into a percentage grade with 50% of the grade on it determined by the quality grades given by an instructor and 50% determined by the completion scores. *Activity Guide Units are due at the beginning of the class period following the class in which the last session activities are to be done*. Late Activity Guides take teaching assistants and instructors much longer to review. In order to discourage late work, the grade on the Activity Guides will be reduced by 10% for each day or part of a day after the due date unless a written notification of illness is provided by Student Services or the Health Centre.

Homework Assignments

After each class session there will be homework assignments to complete; the assignments are specified on pages appended to the end of the unit which you are currently working on. Sometimes you will need to finish activities you started during class. This out-of-class work will typically take two or more hours to complete after each class session. A typical student can expect to work about 6 to 7 hours each week out of class.

Homework is due at the beginning of every class session. Some of the homework assignments will consist of questions based on class activities, others are warm-up exercises involving simple reasoning and mathematics, while others are fairly difficult mathematical problems. Some of these will be adapted from problems in your text book. Each homework assignment is to be handed in at the beginning of the class session on the date that it is due. *No late assignments will be accepted*. Students who have been ill should arrange with the instructor to hand in make-up assignments.

Homework should be submitted on the pages provided at the end of each unit or on an 8 1/2" X 11" sheet of paper headed with your name, the date, and your section number. In cases where textbook problems have been assigned, an assignment summary (for example, Ch 2 -#Q3, 13, 14, 21 should be placed on the header, if you are assigned question 3 and problems 13, 14, and 15 in Chapter 2).

Textbook Problem Assignments: If you want advice on how to solve problems we suggest:

1. Reading the problem solving guidelines of your text

2. Studying sample solutions in the text.

3 Studying sample solutions in other books of physics problems.

In the case of textbook-style problems full credit will be assigned for a correctly worked problem that contains a diagram, brief description of the physical situation and calculations. *You will receive at least half credit for seriously attempting to solve a problem using diagrams, descriptions, and mathematics even if your ultimate solution is incorrect. To receive partial credit you must explain in writing what approaches you have taken to solving the problem.*

Remember: In order to get full credit on a problem, the solution should contain a diagram of the physical situation, a brief written description of the situation, and calculations.

Homework solutions will be made available when the graded homework is handed back. Homework will usually be graded by an a graduate student or upper level undergraduate in physics. Your grader may occasionally make an error in judgement. *If you think this is the case, feel free to ask the instructor to review your homework assignment.* At the end of the semester your homework scores will be translated into a percentage grade.

You are encouraged to discuss and work on homework with classmates. However, you should write out answers to questions and problem solutions using your own format, equations, and words to reflect the understanding of the assignment. As is the case for Activity Guide Entries *any student who copies homework from another student will be reported for plagiarism.*

We have noted in the past that there is a strong correlation between the steady effort needed to successfully complete homework and performance on examinations. For example, during a recent year 7 out of the 8 students with exam averages above 90% had homework averages of over 80%.

Ungraded Diagnostic Quizzes

During a few class periods, you may be asked to answer a short series of multiple choice questions without reference to notes. Some of these questions pertain to concepts you should have learned, while other questions are about material you will be covering and ought to be able to answer once you have completed future activities. These questions will help you and your instructors gauge your progress as you move through the course. Answers will be provided to you after you take a diagnostic quiz. *Quiz scores will not count toward your grade.*

Physics 141: Formal Laboratory Report

During the middle of the second semester there will be one experiment that is designated to have a formal laboratory report written for it. *Each formal report must be word processed with data and graphs included in appropriate places in the main body of the text rather than tacked on at the end.* Each report will be graded and returned for revision. After it is revised by you, it will be resubmitted and the instructor will assign a second grade to it. *The laboratory project and due dates for the laboratory reports will be announced sometime during each semester.*

The first write-up of each lab experiment should be completed with careful attention to the eight items listed below. Although you and your laboratory partners will probably present the same data in reports and share graphs, tables, and diagrams, *each member of a group*

must submit a laboratory report written in his or her own words. Your write-up will be graded and returned with extensive comments. You should rewrite your report paying careful attention to the comments. The rewrite will be graded with higher standards being used for the second submission. Each of the reports will count equally in determining your grade on formal laboratory reports.

As you write your reports, imagine that the audience consists of introductory physics students from another college who have not seen the apparatus or done the experiment you have done. Would such a reader be able to understand what you did? Would that reader know how you did it and what the significance of your results is? Each laboratory write up should include the following:

ELEMENTS OF A LABORATORY REPORT

1. The date, course name and number, and your section;

2. Your name, the name of your partner(s), and the project title;

3. A statement of the purpose of the project or experiment;

4. A summary of relevant theory and equations. If the key equations used in calculations are not derived in your text, they should be derived in this section of the report. You may want to look up and cite some other references that provide you with added theoretical grounding for the project;

5. A description of the procedures and equipment used. Include an apparatus drawing with appropriate labels attached;

6. Data *clearly labelled with units* (usually presented in tabular form);

7. Calculations and data analysis with each step displayed for at least one sample calculation of each type. (**Note:** *This means that the equations used to calculate each column in a spread sheet should be presented);*

8. Results displayed in the form of graphs with axes labelled with *units*;

9. A discussion of results and conclusions including an assessment of the sources of uncertainty and suggestions for improvement of the experiment.

EXAMINATIONS

There will be two midterm examinations during each semester as well as a cumulative final exam. Questions on these examinations will be based primarily on course activities and homework assignments. Emphasis will be placed on demonstration of the ability to apply the concepts and techniques learned to *new* situations. Material for the examinations will be drawn from the Activity Guide, assigned problems, and text readings as well as from oral presentations by instructors. You may refer to personal notes based on oral presenta-

tions in examinations. In addition, unless we specify otherwise, *examinations will be open to the Activity Guide and other written material that you generated during the course*. *Examinations will not be open to the textbook, other books, published exam solutions, and other people's ideas*. You may use an electronic calculator.

Working old examinations, additional problems, and previously assigned problems, as well as reviewing assigned readings and your written Activity Guide work, is probably the best way to prepare for an examination. Each exam will have a section on (1) concepts, (2) observations or data analysis, and (3) problems. Although successful completion of examinations will require a working knowledge of key definitions, concepts, and problem solving techniques, *rote memorization of material will not help you to pass examinations*.

POLICIES

Cutting – Missing class without a valid excuse is discouraged because make-up classes pose difficulties.

Athletics – Participation in athletic events will not ordinarily be considered a legitimate excuse for missing class. Athletes who have practice sessions or contests in the afternoons should try to take a morning section of the course to avoid conflicts.

Making Up Excused Absences – Any class period missed for which there is a legitimate excuse must be made up at a time arranged for in advance.

Respect for Equipment – We expect you to be careful with the lab equipment. *At the end of every class period your table should be left with equipment arranged neatly, computer equipment off, and scrap materials thrown away.*

Late Work – Because it is helpful to your learning to have rapid feedback on your written work, the instructors will try to see that all work is graded as soon as possible. *It is very inconsiderate to expect an instructor or teaching assistant to grade late work once the same work from the rest of the students has been graded*. It takes 2-3 times longer to grade late work separately. For these reasons, your instructor will not accept home work assignments or laboratory reports handed in after that particular assignment has been graded. The grades on late Activity Guide Units will be reduced by 10% for each day that they are late.

Academic Honesty – You are encouraged to discuss and debate the ideas in any of your assignments with your instructors, TA's, lab partners, and other classmates. If you work on assignments co-operatively, rather than independently, you may share ownership of spreadsheet, graph, and diagram files based on data you have taken with partners. However, *any other spreadsheet or written assignments must be expressed in your own words* and reflect your own format details. Thus, you may not copy (even with some modification) problem solutions or spreadsheet assignments, Activity Guide entries, or written material on examinations. *If there is reasonable evidence of copying, it will be construed as an act of plagiarism and will be dealt with according to the university policy on academic dishonesty.*

TIME COMMITMENT: 6 HR/WK + 6 HR/WK = 12 HR/WK

Understanding the science of physics and learning how to investigate natural phenomena on your own can be fun, but it also takes energy, patience, and time. How much time are you expected to put into the calculus-based introductory courses? What do we expect? How does that compare with the average study time at other colleges?

Most university and colleges recommend that students plan on working three hours out-of-class for every hour spent in class. If Physics 140-141 were taught in the more traditional format of three lectures each week, we would be requiring an average of nine additional hours outside of the lecture setting. Three of these hours would be spent in a weekly laboratory session and the other six would be spent working informally, either independently or with classmates, to complete assigned work. This adds up to a total of twelve hours per week in course related activities. The workshop format of this course reallocates the six hours of formal instruction time into three 2 hour long sessions held in an environment where discussions, observations, and experiments can occur. However, *we are still expecting the average student to spend about six hours outside of class each week*. A survey of students at Dickinson college where this course was originally developed revealed that students put in an estimated average of 5.9 hours each week outside of class. There is, of course, a tremendous variation in the amount of time that different individuals put into the course. The time you need to spend will depend on a number of factors, such as how thoroughly you would like to learn the material, your natural ability, and the background you already have in mathematics, physics, equipment use, and writing. Although the amount of time you have to spend each week will vary, steady work from week to week will stave off the need to spend an unreasonable amount of time in any given week. The histogram below shows a distribution of average study hours among typical physics students.

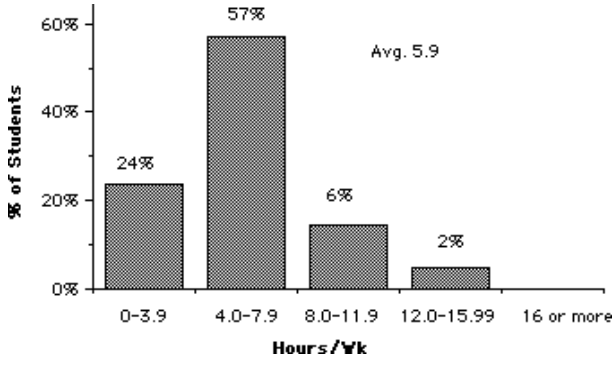

Figure 1: Histogram showing the percentage of Dickinson College students who responded to a survey in the fall of 1989 for different ranges of hours per week of out-of-class study.

Many students who have taken workshop physics have pointed out this course typically requires more work than their other courses. You might be interested in the results of a survey of physics students at Dickinson College (were this course originated) and six other colleges and universities (the University of Oregon, Lynchburg College, Rutgers at Newark, the University of Nebraska, New Mexico State University, and Arizona State University). The average amount of work done at these institutions is similar. This is shown below.

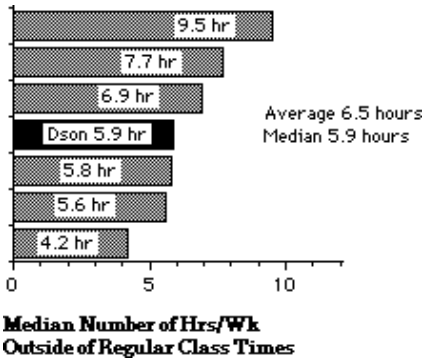

Figure 2: Bar Graph of the median number of hours spent in out-of-class study for introductory physics courses at seven colleges and universities.

Physics courses at SFU may require more work than many other courses you may have taken in high school or university, but the work load is not out-of-line with that required in physics at other colleges and universities. Learning how to analyse data, describe natural phenomena mathematically, and use new apparatus and computer tools involve high order thinking skills that only come with practice. Former students who pursue careers or undertake graduate study in a number of fields of endeavour find the increase in thinking ability and the background they have obtained to be extremely valuable. Although you will be expected to put considerable effort into the Physics 140 and 141 courses, we hope you will enjoy the activities and take a real pride in your growing ability to learn about the wonders of nature by conducting your own investigations using modern computers and scientific apparatus.

GRADING

Your grade will be based on a professional judgement of your work using the following weighting scheme as a guide:

	Physics 140	Physics 141
• Term Examinations (2)	30%	30%
• Final Examination	40%	20%
• Written Homework	15%	15%
• Activity Guide Entries	15%	15%
• Practical Lab Exam		10%
• Formal Laboratory Report		10%
TOTAL	**100%**	