GPRC

DEPARTMENT OF ACADEMIC UPGRADING

COURSE OUTLINE PC0130 A2 F12
PC0130 - Physics Grade 12 Equivalent– Fall 2012

INSTRUCTOR: Sheryl Heikel   **PHONE:** Office: 780–539–2059
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OFFICE HOURS: 12:30pm - 1:30 pm (except Tuesdays)
or by appointment

PREREQUISITE(S)/COREQUISITE:
PC0120 (or Physics 20)
and MA0122 (Math 20-2) or MA0120 (Math 20-1) or MA0130 placement.

REQUIRED TEXT/RESOURCE MATERIALS:
Pearson Physics (text is currently available online in pdf form at http://www.physicssource.ca/index2.html)
Scientific calculator (if you need to purchase TI-30X IIS is recommended)
Lab book (black hardcover physics lab book)
3-ring binder
graph paper (fine lined *10 lines/cm* - may be printed from Moodle)
NOTE: There are approximately 250 pages of recommended printing for this course.

CALENDAR DESCRIPTION:
Physics Grade 12 Equivalent 5 (5-0-1.5) HS
Concepts in this course include: momentum and impulse; electric forces and fields; current electricity; magnetic forces and fields; electromagnetic radiation (light); and atomic physics. Understanding of physics theory, problem solving and lab skills are emphasized.

CREDIT/CONTACT HOURS: 5 credits; 6.5 contact hours per week

DELIVERY MODES: Classroom instruction and lab. Use of Moodle required.

TRANSFERABILITY:
Grade of D or D+ may not be acceptable for transfer to other post-secondary institutions. Students are cautioned that it is their responsibility to contact the receiving institutions to ensure transferability.

LEARNING OUTCOMES: Please see Course outline which follows (pages 5-8).

Important Dates: **No class Thursday Nov 8** (in lieu of lecture Monday Oct 29)
     Last day to Withdraw with refund **September 21**
       Withdraw with permission **November 2**

GRADING CRITERIA:

	GRANDE PRAIRIE REGIONAL COLLEGE		
	GRADING CONVERSION CHART		
Alpha Grade	4-point Equivalent	Percentage Guidelines	Designation
A^+	4.0	90 – 100	EXCELLENT
A	4.0	85 – 89	
A^-	3.7	80 – 84	FIRST CLASS STANDING
B^+	3.3	77 – 79	
B	3.0	73 – 76	GOOD
B^-	2.7	70 – 72	
C^+	2.3	67 – 69	SATISFACTORY
C	2.0	63 – 66	
C^-	1.7	60 – 62	
D^+	1.3	55 – 59	MINIMAL PASS
D	1.0	50 – 54	
F	0.0	0 – 49	FAIL
WF	0.0	0	FAIL, withdrawal after the deadline

EXAMINATIONS:

All tests and exams MUST be written at the scheduled times unless **PRIOR** arrangements have been made with the instructor. A missed test (exam) will result in a score of ZERO on that test (exam). Only in very specific cases may student be given an opportunity to make up a missed exam (student will be presented with a different version of the exam). Doctor, lawyer or police documentation will be required. The final exam is 3 hours long and is scheduled by the registrars' office during GPRC Exam weeks.

STUDENT RESPONSIBILITIES:

Attendance: Regular attendance is expected of all students and is crucial to good performance in the course. Class interruption due to lateness will **NOT** be permitted. You may be debarred from the final exam if your absences exceed 15% of class days (10 lecture classes).

AUD Student Classroom Deportment Guidelines The Academic Upgrading Department is an adult education environment. Students are expected to show respect for each other as well as faculty and staff. They are expected to participate fully in achieving their educational goals.

Certain activities are disruptive and not conducive to an atmosphere of learning. In addition to the *Student Rights and Responsibilities* as set out in the College calendar, the following guidelines will maintain an effective learning environment for everyone. We ask the cooperation of all students in the following areas of classroom deportment.
1. Students are expected to turn off cell phones during class time or in labs. **NO texting in class.**
   No unspecified electronic devices will be allowed in exams.
2. Refrain from disruptive talking or socializing during class time.
3. Be respectful of others regarding food or beverages in the classroom.
   Clean up your eating area and dispose of garbage.
4. Recycle paper, bottles, and cans in the appropriate containers.
5. Students are expected to **arrive on time and to remain for the duration of scheduled class**.
6. Children are not permitted in the classrooms.
7. Students are expected to notify his/her instructor of any extenuating circumstances.

STATEMENT ON PLAGIARISM AND CHEATING: Refer to the Student Conduct section of
the College Admission Guide at http://www.gprc.ab.ca/programs/calendar/ or the College Policy on Student Misconduct: Plagiarism and Cheating at www.gprc.ab.ca/about/administration/policies/**
        **Note: all Academic and Administrative policies are available on the same page.

COURSE SCHEDULE/TENTATIVE TIMELINE:

Physics 0130 consists of four units

		Tentative Exam dates
A. Momentum and Impulse	(text ch9)	September 26
B. Forces and Fields	(text ch10-12)	October 19
Midterm Exam 20%		October 25
C. Electromagnetic Radiation	(text ch13)	November 20
D. Atomic Physics (as time permits)	(text ch14-16)	December 11

EVALUATION:

Course final grade will be based on the following components.

4 Unit Tests	35%	The final exam is 3 hours long and is
Labs, Assignments, Quizzes	15%	scheduled by the registrars' office during
Midterm Exam	20%	Exam weeks. Final Grades will be
Final Exam	30%	assigned on the Letter Grading System.

LABS:
• Attendance is compulsory in all labs.
• Missed labs receive a mark of zero. **There are NO make-up labs.**
• If you are late and have missed the lab safety discussion, you will be excluded
      from participating in the lab and will receive a mark of zero.
• Late lab reports will result in a penalty of 20% per day.
      Labs over two days late will not be graded without PRIOR approval.
• Pre-lab assignments, procedure write-up and data tables must be complete
      and ready for data **BEFORE** you enter the lab.

Lab Schedule   Mondays   L1 2:30 - 4:20 pm

Pre-lab assignments and procedure write-up must be complete BEFORE you may
enter the physics lab. If you are late and have missed the lab safety discussion, you
may be excluded from participating and forfeit the marks for this lab.

Date	Lab	Room	Title
Sep 10	**online**	**A205**	review "Conservation of Energy"
Sep 17	Lab 1 (unit A)	**J103**	Momentum in One Dimension
Sep 24	Lab 2 (Unit A)	**A211**	Momentum in Two Dimensions
Oct 2	Lab 3 (Unit B)	**J103**	Electrostatics
Oct 8	**Thanksgiving Holiday**		
Oct 15	Lab 4 (Unit B)	**J103**	Ohm's Law, Circuits, Series/Par
Oct 22	Lab 5 (Unit B)	**J103**	Magnetic Field-Current Balance
Oct 29	**Lecture**	**A211**	2:30 - 3:50
Nov 5	Lab 6 (Unit C)	**J103**	Reflection, Refraction of Light
Nov 12	**Fall break**		
Nov 19	Lab 7 (Unit C)	**J103**	Focal lengths of Convex Lenses
Nov 26	**no class no lab**		
Dec 3	Lab 8 (Unit D)	**J103**	Balmer series of hydrogen
Dec 10	**Lecture**	**A211**	2:30 - 3:50

Physics 0130 Lab Reports
YOU MUST HAVE A BLACK HARD COVER PHYSICS LAB BOOK.

*Labs must be in **ink** and **hand written** with the <u>exception</u> that diagrams, data tables, graphs, vector diagrams and example calculations may be in pencil. Data tables must be ready for the input of data **BEFORE** lab begins.*

Title - Center page, top. Each lab begins on a right hand page
Date - Top right corner

Your name -   Top RIGHT corner
Lab partners names, if any -   top LEFT corner

Objective - a short explanation of what it is you wish to test, study, or determine in the lab. Include your experimental design (manipulated, controlled and responding variables) and/or hypothesis (an educated guess as to what will happen) if applicable.

Apparatus or Materials - list of those materials required to duplicate the lab. This may include a diagram if it helps to explain how the equipment is set up.

Theory - This includes physics formulae and any physics theory you must know in order to be able to understand the lab.

Procedure - Sufficient explanation that would enable someone else, not in the lab, to duplicate or repeat the experiment and verify your results. A diagram may be included here if it helps explain how to use or what to do with the equipment.

Observations or Data Collection (written observations and data tables)
<u>Data Tables</u>
- units are found only at column heads and not within the data columns.
- all data in a column are the same number of decimal places and to same power of 10.This may mean that the runs of significant digits and scientific notation are ignored for some data.
A diagram may be included here if it helps to explain something you <u>observed</u> or saw happening in the lab.

Analysis - the **MEAT** of the lab - includes any, some, or all of the following:
<u>Results</u>
<u>Example calculations</u> - **one** of each type or formula you used. Include all units.
<u>Graphs</u> - these are a tool to analyze data. (Tape in flat with no flip edges)
Discussion of <u>sources of error</u> - this is unavoidable error, not poor technique
<u>% error calculations</u>
<u>Answers to any questions</u> asked in the lab

Conclusion - Evaluate your objective and your hypothesis. State what you have accomplished, discovered, or verified. Were you correct in your hypothesis?

**PC0310 Detailed Course Outline
and Learning Objectives**

Review from Physics 20: Conservation of Energy

Key Concepts:
- conservation of mechanical energy
- work-energy theorem
- isolated systems
- mechanical energy
- power

Conservation of Mechanical energy in conservative and non-conservative systems.
Work is a transfer of energy.
Conservation of energy in an isolated system is afundamental physical concept.

- define mechanical energy as the sum of kinetic and potential energy
- determine, quantitatively, the relationships among the kinetic, gravitational potential and total mechanical energies of a mass at any point between maximum potential energy and maximum kinetic energy
- analyze, quantitatively, kinematics and dynamics problems that relate to the conservation
of mechanical energy in an isolated system
- recall work as a measure of the mechanical energy transferred and power as the rate of doing work
- describe power qualitatively and quantitatively
- describe, qualitatively, the change in mechanical energy in a system that is not isolated.

Unit A: Momentum and Impulse

Key Concepts:
- impulse
- momentum
- Newton's laws of motion
- elastic collisions
- inelastic collisions

General Outcomes: Students will:
Explain how momentum is conserved when objects interact in an isolated system.
- define momentum as a vector quantity equal to the product of the mass and the velocity of an object
- explain, quantitatively, the concepts of impulse and change in momentum, using Newton's laws of motion
- explain, qualitatively, that momentum is conserved in an isolated system
- explain, quantitatively, that momentum is conserved in one- and two-dimensional interactions in an isolated system
- define, compare and contrast elastic and inelastic collisions, using quantitative examples, in terms of conservation of kinetic energy.

Unit B: Forces and Fields
Key Concepts:

- electric charge
- conservation of charge
- Coulomb's law
- vector fields
- electric field

- magnetic field
- electric potential difference
- interaction of charges with electric and magnetic fields
- electromagnetic induction

General Outcomes: Students will:

1. explain the behavior of electric charges, using the laws that govern electrical interactions
   - explain electrical interactions in terms of the law of conservation of charge
   - explain electrical interactions in terms of the repulsion and attraction of charges
   - compare the methods of transferring charge (conduction and induction)
   - explain, qualitatively, the distribution of charge on the surfaces of conductors and insulators
   - explain, qualitatively, the principles pertinent to Coulomb's torsion balance experiment
   - apply Coulomb's law, quantitatively, to analyze the interaction of two point charges
   - determine, quantitatively, the magnitude and direction of the electric force on a point charge due to two or more other point charges in a plane
   - compare, qualitatively and quantitatively, the inverse square relationship as it is expressed by Coulomb's law and by Newton's universal law of gravitation.
   - Basic circuits, Ohm's Law and resistors in series and parallel

2. describe electrical phenomena, using the electric field theory
   - define vector fields
   - compare forces and fields
   - compare, qualitatively, gravitational potential energy and electric potential energy
   - define electric potential difference as a change in electric potential energy per unit of charge
   - calculate the electric potential difference between two points in a uniform electric field
   - explain, quantitatively, electric fields in terms of intensity (strength) and direction, relative to the source of the field and to the effect on an electric charge
   - define electric current as the amount of charge passing a reference point per unit of time
   - describe, quantitatively, the motion of an electric charge in a uniform electric field
   - explain, quantitatively, electrical interactions using the law of conservation of energy

3. explain how the properties of electric + magnetic fields are applied in technologies.
   - describe magnetic interactions in terms of forces and fields
   - compare gravitational, electric and magnetic fields (caused by permanent magnets and moving charges) in terms of their sources and directions
   - describe how the discoveries of Oersted and Faraday form the foundation of the theory relating electricity to magnetism
   - describe, qualitatively, a moving charge as the source of a magnetic field and predict the orientation of the magnetic field from the direction of motion
   - explain, qualitatively and quantitatively, how a uniform magnetic field affects a moving electric charge, using the relationships among charge, motion, field direction and strength, when motion and field directions are mutually perpendicular
   - explain, quantitatively, how uniform magnetic and electric fields affect a moving electric charge, using the relationships among charge, motion, field direction and strength, when motion and field directions are mutually perpendicular
   - describe and explain, qualitatively, the interaction between a magnetic field and a moving charge and between a magnetic field and a current-carrying conductor
   - explain, quantitatively, the effect of an external magnetic field on a current-carrying conductor
   - describe, qualitatively, the effects of moving a conductor in an external magnetic field, in terms of moving charges in a magnetic field.

Unit C: Electromagnetic Radiation

Key Concepts:

– calculate the energy difference between states, using the law of conservation of energy and the observed characteristics of an emitted photon

• speed of EMR
• propagation of EMR
• reflection
• refraction
• diffraction
• interference
• total internal reflection
• Snell's law

General Outcomes: Students will:

1. explain the nature and behavior of EMR, using the wave model
   * describe, qualitatively, how all accelerating charges produce EMR
   * compare and contrast the constituents of the electromagnetic spectrum on the basis of frequency and wavelength
   * explain the propagation of EMR in terms of perpendicular electric and magnetic fields that are varying with time and travelling away from their source at the speed of light
   * explain, qualitatively, various methods of measuring the speed of EMR
   * calculate the speed of EMR, given data from a Michelson-type experiment
   * describe, quantitatively, the phenomena of reflection and refraction, including total internal reflection
   * describe, quantitatively, simple optical systems, consisting of only one component, for both lenses and curved mirrors
   * describe, qualitatively, diffraction, interference and polarization
   * describe, qualitatively, how the results of Young's double-slit experiment support the wave model of light
   * solve double-slit and diffraction grating problems using

$$\lambda = \frac{xd}{nl} \qquad \lambda = \frac{d\sin\theta}{n}$$

   * describe, qualitatively and quantitatively, how refraction
   * supports the wave model of EMR, using

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$$

   * compare and contrast the visible spectra produced by diffraction gratings and triangular prisms.

Unit D: Atomic Physics

Key Concepts:

• charge-to-mass ratio (Thomson's experiment)
• charge quantization—Millikan's experiment
• models of the atom (Dalton, Thomson, Rutherford, Bohr, de Broglie)
• spectra: continuous, line emission and line absorption
• Balmer formula for hydrogen
• energy levels (states)

• de Broglie hypothesis
• quantum mechanical model
• half-life
• nuclear decay
• nuclear reactions
• Standard Model of matter
• photoelectric effect
• Compton effect
• Uncertainty Principle

General Outcomes: Students will:

1. explain describe the electrical nature of the atom

- describe matter as containing discrete positive and negative charges
- explain how the discovery of cathode rays contributed to the development of atomic models
- explain Millikan's oil-drop experiment and its significance relative to charge quantization.
- explain J. J. Thomson's experiment and the significance of the results for both science and technology
- explain, qualitatively, the significance of the results of Rutherford's scattering experiment, in terms of scientists' understanding of the relative size and mass of the nucleus and the atom.

2. describe the photoelectric effect, using the quantum model.

- define the photon as a quantum of EMR and calculate its energy
- classify the regions of the electromagnetic spectrum by photon energy
- describe the photoelectric effect in terms of the intensity and wavelength or frequency of the incident light and surface material
- describe, quantitatively, photoelectric emission, using concepts related to the conservation of energy
- describe the photoelectric effect as a phenomenon that supports the notion of the wave-particle duality of EMR
- explain, qualitatively and quantitatively, the Compton effect as another example of wave-particle duality, applying the laws of mechanics and of conservation of momentum and energy to photons.

3. describe the quantization of energy in atoms and nuclei

- explain, qualitatively, how emission of EMR by an accelerating charged particle invalidates the classical model of the atom
- describe that each element has a unique line spectrum
- explain, qualitatively, the characteristics of, and the conditions necessary to produce, continuous line-emission and line-absorption spectra
- Quantitatively predict the wavelength for the photon emitted by hydrogen during a specific energy level change.
- explain, qualitatively, the concept of stationary states and how they explain the observed spectra of atoms and molecules
- explain, qualitatively, how electron diffraction provides experimental support for the de Broglie hypothesis
- describe, qualitatively, how the two-slit electron interference experiment shows that quantum systems, like photons and electrons, may be modeled as particles or waves, contrary to intuition.
- describe, qualitatively, how the Compton effect contributed to the acceptance of the wave particle duality for light.
- Calculate the change in wavelength in Compton scattering.

4. describe nuclear fission and fusion as powerful energy sources in nature

- describe the nature and properties, including the biological effects, of alpha, beta and gamma radiation
- write nuclear equations, using isotope notation, for alpha, beta-negative and beta-positive decays, including the appropriate neutrino and antineutrino
- perform simple, nonlogarithmic half-life calculations
- use the law of conservation of charge and mass number to predict the particles emitted by a nucleus

- compare and contrast the characteristics of fission and fusion reactions
- relate, qualitatively and quantitatively, the mass defect of the nucleus to the energy released in nuclear reactions, using Einstein's concept of mass-energy equivalence.