Grande Prairie Regional College
Department: Academic Upgrading

COURSE OUTLINE - Fall 2010
PC0130 - Physics Grade 12 Equivalent

INSTRUCTOR: Sheryl Heikel
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OFFICE HOURS: 11:00 - 12:00 am Mondays and Thursdays
11:30-12:30 Thursdays or by appointment

PREREQUISITE(S)/COREQUISITE:
PC0120 or equivalent, and MA0120 or equivalent or MA0130 placement.

REQUIRED TEXT/RESOURCE MATERIALS:
Pearson Physics
Scientific calculator
Lab book (bound or coil -no more than 140 pages)
3-ring binder
graph paper (fine lined may be printed from Moodle)

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. Both understanding of physics theory, problem solving and lab skills are emphasized.

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

DELIVERY MODE(S): Classroom instruction and lab
Use of Moodle site 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.

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). The final exam is 3 hours long and is scheduled by the registrars' office during 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% (10 days) of class days.

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 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 classe.
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: Please refer to pages 49-50 of the College calendar regarding plagiarism, cheating and the resultant penalties. These are serious issues and will be dealt with severely.

COURSE SCHEDULE/TENTATIVE TIMELINE:

Physics 0130 consists of four units

	Tentative Exam dates
A. Momentum and Impulse (text ch9)	Sep 22
B. Forces and Fields (text ch10-12)	Oct 20
Midterm Exam 20%	Oct 25
C. Electromagnetic Radiation (text ch13)	Nov 10
D. Atomic Physics (as time permits) (text ch14-16)	Dec 3

EVALUATION:

Course final grade will be based on the following components.

4 Unit Tests (5%, 10%, 10%, 10%)	35%
Labs + Assignments	15%
Midterm Exam	20%
Final Exam	30%

The final exam is 3 hours long and is scheduled by the registrars' office during Exam weeks. Final Grades will be assigned on the Letter Grading System.

Labs: Attendance is compulsory in all labs. A missed lab will result in a score of ZERO in that lab. Make-up labs CANNOT be guaranteed. If you are late and have missed the lab safety discussion, you may be excluded from participating and forfeit the marks for this lab. Late lab reports will result in a penalty of 10% per day. Labs handed in after two days will not be graded without PRIOR approval.

Lab Schedule Mondays L1 12:30 - 2:20 pm J103

Pre-lab assignments and procedure write-up must be complete BEFORE you may enter the chemistry 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.

Sept. 6	NO LAB - holiday	
Sept. 13	Lab 1 (unit A)	Momentum in One Dimension
Sept. 20	Lab 2 (Unit A)	Momentum in Two Dimensions
Sept. 27	Lab 3 (Unit B)	Electrostatics
Oct. 4	Lab 4 (unit B)	Ohm's Law , Circuits, Series and Parallel
Oct. 11	NO LAB - holiday	
Oct. 18	Lab 5 (Unit B)	Magnetic Field in a Solenoid - Current Balance
Oct. 25	**Midterm**	
Nov. 1	Lab 6 (Unit C)	Reflection, Refraction of Light
Nov. 8	**Lecture**	Time and location to be announced
Nov. 15	Lab 7 (Unit C)	Focal lengths of Convex Lenses
Nov. 22	**Lecture**	Time and location to be announced
Nov. 29	Lab 8 (Unit D)	Balmer series of hydrogen
Dec. 6	NO LAB	

Physics 0130 Lab Reports

*Labs must be in **ink** and **hand written** with the exception 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 balanced chemical formulae and any chemistry 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 - includes both written observations and data tables. In Data Tables units are found only at column heads and not within the data columns. A diagram may be included here if it helps to explain something you observed or saw happening in the lab.

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

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
- charge quantization—Millikan’s experiment
- electromagnetic induction

General Outcomes: Students will:

1. explain the behaviour 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.

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
   - explain Millikan’s oil-drop experiment and its significance relative to charge quantization.

3. explain how the properties of electric and magnetic fields are applied in numerous devices.
   - 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 behaviour 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 $\lambda = \frac{xd}{nl}$, $\lambda = \frac{d\sin\theta}{n}$
   - solve double-slit and diffraction grating problems using,
   - 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)
- classical model of the atom (Rutherford, Bohr)
- spectra: continuous, line emission and line absorption
- energy levels (states)
- de Broglie hypothesis
- quantum mechanical model
  - half-life
  - nuclear decay
  - nuclear reactions
  - Standard Model of matter
  - photoelectric effect
  - Compton effect

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 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. 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
   – 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 modelled as particles or waves, contrary to intuition.

As time permitts:

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.

5. describe the ongoing development of models of the structure of matter.
   - explain how the analysis of particle tracks contributed to the discovery and identification of the characteristics of subatomic particles
   - explain, qualitatively, in terms of the strong nuclear force, why high-energy particle accelerators are required to study subatomic particles
   - describe the modern model of the proton and neutron as being composed of quarks
   - compare and contrast the up quark, the down quark, the electron and the electron neutrino, and their antiparticles, in terms of charge and energy (mass-energy)
   - describe beta-positive ($ß^+$) and beta-negative ($ß^-$) decay, using first-generation elementary fermions and the principle of charge conservation (Feynman diagrams are not required).