DEPARTMENT OF ACADEMIC UPGRADING

COURSE OUTLINE PC0130 A3 B3 W16
PC0130 - Physics Grade 12 Equivalent 5 (5-0-1.5) HS – Winter 2016

INSTRUCTOR: Sheryl Heikel **PHONE:** Office: 780–539–2059
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OFFICE HOURS: Tuesday /Thurs 10:00 – 11:00am
Or by appointment

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

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
Scientific calculator (if you need to purchase TI-30X IIS is recommended)
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: PC0130 - Physics Grade 12 Equivalent 5 (5-0-1.5) HS
The major concepts to be covered in this course include: momentum and impulse; electric forces and fields; current electricity; magnetic forces and fields; electromagnetic radiation (light); and atomic physics. Problem solving is highly emphasized throughout the course.

COURSE OBJECTIVES: ***Students will:***
Conservation of Energy (Physics 20 review)
- Describe Work as a transfer of energy
- Describe conservation of Mechanical energy in conservative and non-conservative systems.
- Explain conservation of energy in an isolated system is a fundamental physical concept.

Momentum and Impulse
- Explain how momentum is conserved when objects interact in an isolated system.

Forces and Fields
- explain the behavior of electric charges, using the laws that govern electrical interactions
- describe electrical phenomena, using the electric field theory
- explain how the properties of electric + magnetic fields are applied in technologies.

Electromagnetic Radiation • explain the nature and behavior of EMR, using the wave model
Atomic Physics • explain describe the electrical nature of the atom
- describe the photoelectric effect, using the quantum model.
- describe the quantization of energy in atoms and nuclei
- describe nuclear fission and fusion as powerful energy sources in nature

Lab Skill objectives (focus on scientific inquiry)
- Initiate, Plan, Perform, Record, Analyze, Interprete, Communicate and work in a Team

LEARNING OUTCOMES: Please see Course outline which follows (pages 4-9).

COURSE SCHEDULE / TENTATIVE TIMELINE:

Physics 0130 consists of four units (approx. 3 weeks each)

A. Momentum and Impulse (text ch9)
B. Forces and Fields (text ch10-12)
Midterm Exam 20%
C. Electromagnetic Radiation (text ch13)
D. Atomic Physics (as time permits) (text ch14-16)

Tentative Exam dates
January 27
March 2
March 7
March 18
April 13

EVALUATIONS: Course final grade will be based on the following components.

4 Unit Tests (equally weighted)	35%	
Labs, Assignments, Quizzes	15%	**Late penalty 20% per day for 2 days.**
Midterm Exam (Units A + B)	20%	
Final Exam (Units A, B, C, D)	30%	

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 may be required. The final exam is 3 hours long and is scheduled by the registrars' office during GPRC Exam weeks.

GRADING CRITERIA: Final Grades will be assigned on the Letter Grading System.

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*

STUDENT RESPONSIBILITIES:

Refer to the College Policy on Student Rights and Responsibilities at https://www.gprc.ab.ca/files/forms_documents/StudentRightsandResponsibilities.pdf

STATEMENT ON PLAGIARISM AND CHEATING:

Refer to the College Policy on Student Misconduct: Plagarism and Cheating at https://www.gprc.ab.ca/files/forms_documents/Student_Misconduct.pdf

**Note: all Academic and Administrative policies are available at https://www.gprc.ab.ca/about/administration/policies/

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. Please refer to the Alberta Transfer Guide for current transfer agreements.

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. Students are expected to participate fully in achieving their educational goals.

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

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 after yourself.
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.

Labs:

- Attendance is compulsory in all labs.
- Missed labs result in a score 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.
- **Lab reports are due 4:00 pm WEDNESDAY following the lab**. Late lab reports will result in a penalty of 20% per day. Labs over two days late will not be graded without PRIOR approval.
- Download the lab sheets and complete the Pre-lab assignment before the lab period, data tables are completed during the lab and analysis and questions after the lab

Lab Schedule Monday A3 12:30 – 2:20 pm
B3 2:30 – 4:20 pm

Date		Room	Physics 0130
Jan 11			No lab No class
Jan 18	Lab 1	J103	Momentum in 1 Dim (Unit A)
Jan 25	Lab 2	J103	Momentum in 2 Dim (Unit A)
Feb 1	Lab 3	J103	Electrostatics (Unit B)
Feb 8	Lab 4	J103	Simple Circuits – Ohm's Law (Unit B)
Feb 15			Reading week NO LAB
Feb 22			No lab (possible class – check moodle)
Feb 29	Lab 5	J103	Mag Field Current Balance (Unit B)
Mar 7		TBA	MIDTERM
Mar 14	Lab 6	J103	Reflection Refraction (Unit C)
Mar 21	Lab 7	J103	Lenses (Unit C)
Mar 28			No lab (possible class – check moodle)
Apr 4	Lab 8	J103	Diffraction/ Balmer formula (Unit D)
Apr 11			No lab (possible class – check moodle)

PC0310 Learning Outcomes (adapted from Alberta Learning Physics 30 curriculum http://education.alberta.ca/media/654853/phy2030_07.pdf)

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:

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

Lab Skills and objectives are included in labs and assignments in each unit of the course.

Specific Outcomes for Skills (focus on scientific inquiry)

Initiating and Planning

Students will :

- identify, define and delimit questions to investigate
- design an experiment, identifying and controlling major variables
- state a prediction and a hypothesis based on available evidence or background information or on a theory
- evaluate and select appropriate procedures, including appropriate sampling procedures, and instruments for collecting evidence and information

Performing and Recording

Students will :

- research, integrate and synthesize information from various print and electronic sources regarding a scientific question
- select and use appropriate instruments for collecting data effectively, safely and accurately
- carry out procedures, controlling the major variables, and adapt or extend procedures where required
- compile and organize findings and data by hand or computer, using appropriate formats such as diagrams, flowcharts, tables and graphs
- apply Workplace Hazardous Materials Information System (WHMIS) standards to handle and dispose of materials

Analyzing and Interpreting

Students will :

- apply appropriate terminology, classification systems and nomenclature used in the sciences
- interpret patterns and trends in data and predict the value of a variable by interpolating or extrapolating from graphical data or from a line of best fit
- estimate and calculate the value of variables, compare theoretical and empirical values, and account for discrepancies
- identify limitations of data or measurements; explain sources of error; and evaluate the relevance, reliability and adequacy of data and data collection methods
- identify new questions or problems that arise from what was learned
- state a conclusion, based on data obtained from investigations, and explain how evidence gathered supports or refutes a hypothesis, prediction or theory

Communication and Teamwork

Students will :

- work collaboratively to develop and carry out investigations
- select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate findings and conclusions
- evaluate individual and group processes used in planning and carrying out investigative tasks

In this course your lab reports will not be required to follow formal formatting. A template for each lab will be available on the class moodle site.

This page is included for your information. You may, for some future physics course be required to complete a formal lab write-up.

Formal Format for 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 units.
Graphs - these are a tool to analyze data.
(These must be taped or glued 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 the values you determined, discovered or verified. Were you correct in your hypothesis?