Edub 1270 A19 (C&I) PHYSICS 2007 Fall/Winter

Location: Room 300 Education Bldg.
Time: Thursday, 8:30 -10:30 AM
Instructor:
Dr. A. Stinner,
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(Note: Most of my articles are available on PDF in my website)
Websites for my research group:
www.ihpst.uwinnipeg.ca
hsse.uwinnipeg.ca
Each student will receive a CD on which the course outline, the LCPs as well as articles are available for downloading.
Office Hours: Available every day, from Monday to Friday.

Course Description:
This course will focus on the teaching of physics to secondary students in general and on the implementation of the new Manitoba 30S and 40S Physics curriculum document in particular. The course is designed to acquaint the student with the new curriculum as well as the current practices and principles of physics teaching. You can download this document or part of it. See hsse.uwinnipeg.ca and click on resources.

In examining the implicit and explicit philosophy, the rationale, content and the suggested implementation of the physics curriculum, the main goal will be to encourage future physics teachers *to think critically and reflectively about their craft*. We will work on the fundamental requirements of good teaching: sound *content knowledge* and good *pedagogical knowledge*. The first is a necessary but not sufficient condition for successful teaching.

Resource Materials:

1. Parts of the Senior Physics 30S and 40S.(These can be downloaded: http://www.edu.gov.mb.ca/ks4/cur/science/ or download them from our website (see above).
2. Reference articles from such journals as *The Physics Teacher, Physics Education, New Scientist, Science Education, Scientific American, Science Education* (samples of these will be available in Room 300 Education Bldg.).
3. Physics texts, selected texts and literature on topics relevant to optional unit designs, as well as texts on physics methods (some available in Room 300 Education Bldg.).
4. Audio-visual material.
5. Computers, internet, videodiscs, soft-ware and probes for experiments and simulation exercises.
6. Large Context Problems (available on my website or on distributed CDs).

Course Objectives: Upon completion of this course, students should be able to:

1. Become acquainted with the new Physics 30S and 40S Curriculum document.

2. Describe the rationale and objectives for introducing the Physics 30S and 40S Curriculum document in Manitoba;

3. Describe the structure of the 20S Science program;

4. Gain in-depth knowledge of one of the major units in the document;

5. Design a teaching plan and present (in a group of two) one topic of this major unit;

6. Show an understanding and appreciation of the problems associated with the organization and acquisition of laboratory materials.

7. Plan a lesson involving demonstration and/or laboratory work given a specific topic, such as circular motion.

8. Present a critical review of an article on physics teaching, such as articles in *The Physics Teacher*, *Physics Education*, and *Scientific American.*

9. Give a critical assessment of laboratory equipment designed for teaching a specific topic, such as the linear air track to teach momentum conservation and the LASER for discussing interference patterns.

10. Give a critical review of an audio-visual aid such as the movie "Straight Line Kinematics" in the teaching of the equations of kinematics.

11. Demonstrate familiarity with computers, Internet, in experimenting as well as in simulating physics problems.

12. Give a critical review of another student's presentation of a lesson, involving demonstration and/or laboratory work.

13. Demonstrate understanding of proper safety procedures associated with each laboratory exercise.

14. Discuss effective approaches to managing pupils during the performance of laboratory work.

15. Give reasons (content-based and pedagogy-based) as to why laboratory work is important in learning the concepts and theories of physics in the course of study.

The Conventional Sequencing of Topics in Elementary Physics Textbooks:

Classical Physics:
1. Kinematics. 2. Vectors and projectile motion. 3. Newton's laws.
4. Circular motion. 5. Momentum and impulse. 6. The conservation principles of mechanics. 7. Waves. 8. Light and sound. 9. Electric and magnetic phenomena.

Modern Physics.
See section "Modern Physics".

Units for 30S Physics:

1. Waves
Characteristics of all wave motion.

2. The Nature of Light
The wave-particle controversy and the wave-particle duality.

3. Mechanics
Kinematics and dynamics (Vectors, Newton's laws)

4. Fields
The field concept as it is associated with electricity, magnetism and gravity.

Units for 40S Physics:

1. Mechanics:

Mechanics:
Topics: Kinematics, Dynamics, Momentum, Projectile Motion, Circular Motion, Work and energy.

2. Fields:
Topics: Universal gravitation; Artificial Satellites: Exploring Space; The Human Endeavour of Exploring Space, Electric and Magnetic Fields.

3. Electricity:
Topics: Electric Circuits; Electromagnetic Induction;

4. Medical Physics:
See Physics 40S Specific Learning Outcomes.

Assignment I: **Class Presentation:**

Conceptual, Laboratory and Problem-Centred Experiences (CLPCE):
(Groups of two)

(25%)

●Prepare one or two of the topics from the unit you have chosen for classroom teaching. (Consult the section Suggested Contexts for Assignment I).
The groups and the topics should be in place by the second class.

●Each student must sign up (WITH ANOTHER STUDENT) for presenting a general outline involving a conceptual, laboratory and a problem-centered activities in preparation to teaching one major topic chosen from those listed in the Physics 30S and 40S documents. Ideally, you should try to combine the 30S and the 40S, presented as a "story" with a continuity.

●In preparing the topic, set up 4-5 *tables of activity* that allow the class to be engaged sequentially. (The details of this approach will be discussed in the first session). The group of two involved is expected to discuss details (set up of tables, sequencing, the apparatus required, etc with the instructor long before the presentation is to take place.

●You are expected to hand out exercises (conceptual), experimental activity suggestions (laboratory), and questions and problems (Problem-centered Experiences). Your "students" then hand these in to you, and you grade them and hand them back.

● Each student is expected to keep a record of these returned exercises.

● The presenting group of two must hand in an outline of their class presentation, using the following headings:

1. **Topic**
2. **Connections to the physics curriculum**
3. **Main concepts involved.**
4. **Entry Level Knowledge:**
5. **A brief historical account of the main ideas involved.**
6. **Description of tasks planned: Activities for tables outlined**
7. **Summary and self-evaluation**

A draft of this document must be shown to the instructor before the class presentation. The finished document should then be handed, no later than two weeks after the presentation.

See detailed description in the attached document **Assignment 1**
.

Assignment II:

25%

Contextual Teaching using Large Context Problems (LCP).

A group of two chooses one of five LCPs available on your disc. By Day 1 the distribution of the LCPs should be finalized (see titles below). Each LCP should be studied and presented, using the following suggested guide lines:

1. The general idea of the LCP.
2. The connections to the physics curriculum.
3. The main concepts, laws, and "formulas" involved.
4. Examples of problems and questions.
5. The relevance of the context for the students.
6 General (critical evaluation) of the LCP.

Assignment III

Presentation of a topic from modern physics.

(20 %)
Discovery of x-rays (Roentgen, 1895)
Discovery of the electron (J.J. Thomson, 1897)
Einstein and the Photoelectric Effect (1905)
Rutherford's Gold Foil Experiment (1909)
Mary Currie and radioactivity (1900-1910)
Discovery of x-ray diffraction (Max Laue and William Bragg, 1912/13)
Bohr's Theory of the Hydrogen Atom (1913)
Compton's Experiment (Arthur Compton, 1923)
Wave–particle duality (De Broglie 1924)
The diffraction of electrons (D. Thomson, 1927)
Discovery of antiparticles (Paul Dirac and Anderson, 1929, 1933)
Discovery of the neutron (James Chadwick, 1932)

Each student takes one topic and makes a 30 minute presentation. For each topic look up the Nobel Prize acceptance speech and

Assessment:

Assignment I (CLPE)..... 25 %
Assignment II (LCPs)..... . 25 "
Assignment III (Modern Physics).....20 "
Midterm Test.....10 "

Final Examination..... 20 "

100 %

ATTENDANCE IN CLASS IS MANDATORY. SINCE THERE IS A SMALL NUMBER OF STUDENTS, THE SUCCESS OF THIS COURSE IS LARGELY DEPENDENT ON GROUP DISCUSSION, CLASS ACTIVITIES, AND CRITICAL REFLECTION. IF YOU CANNOT MAKE A CLASS, PLEASE CALL THE INSTRUCTOR IN TIME AND LEAVE A MESSAGE ON THE VOICE MAIL: 474-9068 OR E-MAIL.

Final letter grades will be determined as follows:

A+	**95-100**	**Outstanding**
A	**90-94**	**Excellent**
B+	**85-89**	**Very good**
B	**80-84**	**Good**
C+	**75-79**	**Satisfactory**
C	**70-74**	**Pass**
D+	**65-69**	
D	**60-64**	
F	**<64**	

Suggested Contexts for Assignment I:

Kinematics:
Motion around us.
Categorize motion according to the following:

1. Motion with a near-constant speed.
2. Motion with constant acceleration
3. Complex motion that can be described mathematically.
4. Complex motion that cannot be described mathematically.

Dynamics:
The physics of driving
Physics on the Moon.
Physics and bionics.
Physics and Olympic games.

Gravity and Newton's laws of motion
The Motion of Satellites
The Revolving Space Station
The Motion of the Planets

Conservation laws of momentum and kinetic energy
The controversy between Leibniz and Huygens
about the physics of the collision between billiard balls.
The physics of car collisions

Light and Wave Motion
Solar power in the Pyrenees
Voltaic Cells and Electric Energy
The History of the Nature of light

Electricity and Magnetism
Electricity in the Home.
The Physics of Wind Turbines
Electric Cars

Large Context Problems (LCPs) available for assignment 2:

Read the two chapters on contextual teaching in the CD that you were given.

"THE IMPORTANCE OF CONTEXT" and "THE DESIGN AND IMPLEMENTATION OF THE LARGE CONTEXT PROBLEM"

The following are LCPs found in your CD.

(Note: The first three can be downloaded from the website and the two will be available in a few weeks)

1. FROM INTUITIVE PHYSICS TO STARTREK
2. MOTION AND THE PENDULUM
3. THE PHYSICS OF THE LARGE AND SMALL
4. WIND ENERGY
5. THE FLIGHT OF THE SPACE SHUTTLE

C&I PHYSICS (MODERN PHYSICS)

The high school physics teacher should have elementary content knowledge of the topics mentioned below.

What follows is a list of topics. We will choose 10 of these.

For each topic prepare to discuss:

I. The Historical Context
II. The experiment/main ideas involved
III. Implications for the teaching of high school physics

(Get your information from text books, journals, books, Internet...).

Roentgen and the Discovery of X-Rays (1895)

Becquerel and the Discovery of Radioactivity (1896)

J.J. Thomson and the discovery of the electron (1897)

Planck and Black Body Radiation (1900)

Einstein and the Photoelectric Effect

The Special Theory of Relativity (1905)

Rutherford's Gold Foil Experiment (1909)

Bohr's Theory of the Hydrogen Atom (1913)

Millikan's Oil Drop Experiment

Compton’s Experiment (1923)

De Broglie's Particle-Wave Model (1923)

Schroedinger's Wave Mechanics (1926)

Heisenberg's Uncertainty Principle (1926)

Dirac's Theory of Antiparticles (1930)

Discovery of the neutron)James Chadwick, 1932)

The *Standard Model* and the Four Fundamental Forces (1960-)

Big Bang Theory of Cosmology (1948-)

Black Holes (1790-1915-1937-1967-1974)

References to technology (the physics involved) should include:

Nuclear Power Plants (1955-)

The LASER (1960)

Geiger Counters (1913)

Smoke Detectors (1960?)

Transistors and Semiconductors (1949)

Light-Emitting Diodes (1970)

The Electron-Gun (TV) (1897-)

Superconductivity (1913-present)

Microwaves (1949)

Holography (1951-1960)

CAT, EMR. PET and MRI applications in medicine (1970-)

NOTES: