132. 232 (C&I) PHYSICS 2005 Fall/Winter

Location: Room 300 Education Bldg.
Time: Thursday, 8:30 -10:30 AM

Instructor:
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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 (DRAFT) 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.

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*.

Resource Materials:

1. Parts of the Senior Physics 30S and 40S.(These can be downloaded:

   http://www.edu.gov.mb.ca/ks4/cur/science/

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, CD-ROM, videodiscs, soft-ware and probes for experiments and simulation exercises.
6. Internet.

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*, May 1987.

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

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, CD-ROM, 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 (pedagogical and philosophical) as to why laboratory work is important in learning the concepts and theories 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.

Assignments

Assignment Format: Assignments must be typed and neatly presented. The cover sheet must identify the assignment as well as bear the names of the author and the instructor. Notebook comments and the completion of laboratory exercises and problem solutions should be neatly hand written.

Assignment I: **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.

Each student must sign up (WITH ANOTHER STUDENT) for presenting a general outline involving a laboratory and a problem-centered activities in preparation to teaching one topic chosen from those listed in the Physics 30S and 40S documents.

Follow the outline provided for Assignment I.

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Assignment II: Recording of Presentation (part of your notebook you will hand in at the end of the course).

(10%)

1. Presenters are asked to hand out their experiment description as well as their problem exercises at the beginning of their session. "Students" are to complete (individually) the experiment and the problems, and hand them back to the presenters by the following session. The presenters in turn should mark these with comments, sign them, and return them to the "students". You are expected to look through these quickly and give a mark of
1. Excellent, 2. Good. 3. Incomplete. Hand these back to the "students".

"Students" must make sure that copies of both presentations are placed in their notebooks.

"Students" must document all sessions in their notebooks. This section of your notebook should include:

1. a brief critical review of the presentation,

2. the experimental write-up, following the format suggested by the presenters,

3. the complete solutions and comments to sample problems,

4. brief discussion of any difficulties you might expect in using the suggested experiment and the problem-exercises when teaching a given area.

Assignment III: Presentation of a topic from modern physics.

Topics are given below.

(20 %)

Assignment IV: Critical Review of an Article:

(10 %)

Professional growth in science teaching involves the discriminating selection and critical reading (and writing) of literature designed to improve and illuminate the teaching of science (physics). Choose an article from a recent issue of a professional journal specializing in physics teaching, such as *The Physics Teacher* or *Physics Education* (articles chosen from any other journal must have the approval of the instructor), and write a brief critical review (about 1000 words). In writing this review discuss:

1. The relevance of the topic and content to the teaching of secondary school physics.
2. The suitability for teaching the core units of secondary school physics.
3. The reading level: could an average, or a superior high school physics student read it with understanding?
4. The "permanence index" of the article. Articles you find in such journals as *The Scientific American, Scientific American* and to a lesser degree in *The Physics Teacher* and in *Physics Education* have a very high "permanence index": years and even decades later they still seem fresh, readable, and informing.

Note: The article must be connected to one of the topics you presented in class.

Assessment:

Assignment I (CLPE)..... 25 %
Assignment II (Note Books)..... . 10 "
Assignment III (Modern Physics).....20 "
Midterm Test..... 10 "
Assignment IV (Article Review).....10 "
Final Examination..... 25 "

100 %

Note: All assignments are due: ------to be announced in class.

ATTENDANCE IN CLASS IS MANDATORY. SINCE THERE IS A SMALL NUMBER (5-15) OF STUDENTS, THE SUCCESS OF THIS COURSE IS LARGELY DEPENDENT ON GROUP DISCUSSION 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.

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

C&I PHYSICS (MODERN PHYSICS)

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

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)

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-)

Others

NOTES: