SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY
SAULTSTE. MARIE, ON

COURSE OUTLINE

COURSE TITLE: APPLIED PHYSICS II

CODE NO.: PHY118-3 SEMESTER: TWO

PROGRAMS: WATER RESOURCES, ENVIRONMENTAL and PULP & PAPER ENGINEERING TECHNOLOGIES

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APPROVED: G^ . ^A-^

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SCHOOL OF TECHNOLOGY &
TRADES

TOTAL CREDITS: 3

PREREQUISITE(S): APPLIED PHYSICS I PHY100 (OR THE EQUIVALENT)

LENGTH OF COURSE: 3 HOURS/WEEK FOR 16 WEEKS. TOTAL CREDIT HOURS: **48**

I. COURSE DESCRIPTION: This course is the second semester continuation of the semester one physics course, Applied Physics i, PHY100. Like it's semester one prerequisite, the course is intended to introduce the student to **a** number of fundamental concepts of physics which should prove useful to students in the Water Resources, Environmental and Pulp & Paper Engineering Technology programs.

Topics to be covered include: a review of, and a more in depth study of heat and heat transfer which was introduced in PHY100; a review of, and a more in depth study of fluid statics and dynamics which also was introduced in PHY100; the gas laws; thermodynamics; mechanical properties of solids; static electricity; direct current electricity; and magnetism.

The assumption is that many of the students will be seeing most of these concepts for the first time. Because of the number of topics and the potential for difficulties in some of the more complicated areas, the emphasis will be placed on *introducing* the student to the *concepts* **rather than** a *rigorous matliematical analysis* of the topics.

II. LEARNING OUTCOMES AND ELEMENTS OF PERFORMANCE:

(Generic Skills Learning Outcomes placement on the course outline will be determined at a later date)

A. Learning Outcomes:

1) Write definitions for the concepts introduced, preferably in the students own words.

2) Answer questions requiring a knowledge of the concepts presented in class.

3) Respond to questions requiring extrapolation of the course content.

4) Solve mathematical based problems requiring an understanding of the course theory.

5) Apply the knowledge learned in this course to other courses which are 'physics based'.

B. Topics To Be Covered: **Approximate Time Frames (Optional)**

I) HEAT AND HEAT TRANSFER

II) FLUID STATICS AND DYNAMICS

III) THE GAS LAWS

IV) THERMODYNAMICS

V) MECHANICAL PROPERTIES OF SOLIDS

VI) STATIC ELECTRICITY

VII) DIRECT CURRENT ELECTRICITY

C. Learning Outcomes and Elements of the Performance:

Upon successful completion of this course the student will demonstrate the ability to:

I) HEAT AND HEAT TRANSFER

a) methods of heat transfer

1) Describe in detail the processes involved with each of the three methods of heat transfer, namely: *'conduction', 'convection'* and *'radiation'.*

2) List the factors that determine the rate at which heat will flow by *conduction* through a surface.

3) Write the equation used to determine the amount of heat transferred by *conduction* through a surface of given surface area and thickness, subjected to a given temperature difference for a given period of time.

4) Describe what Is meant by the term *'R value'* and write the equation that relates the *R value* to the *'themial conductivity'* of a material.

b) specific heat capacity

1) Explain the meaning of the term *'specific heat capacity.*

2) Write an equation for the term *'specific heat capacity^.*

3) List the units of specific heat capacity in the S.I. metric, C.G.S. metric, "old" M.K.S. metric and Imperial systems of measure.

4) Write a definition for the concept of *'sensible heat.*

5) Write the equation used to determine the *'quantity of sensible heat.*

6) State the value for the specific heat capacity of water in each of the systems of measure listed in learning activity i-b-3.

c) changes of state

1) Explain clearly what is meant by a *'change of state'.*

2) Write the proper term for and discuss the processes that occur for each of the following changes of state: from solid to liquid; from liquid to solid; from liquid to gas; from gas to liquid; from solid to gas; from gas to solid.

d) specific latent heat of fusion

1) Explain the meaning of the term *'specific latent heat effusion'.*

2) Write an equation for the term *'specific latent heat effusion'.*

3) List the units of specific latent heat of fusion in the S.I. metric, C.G.S. metric, "old" M.K-S. metric and Imperial systems of measure.

4) State the value of the specific latent heat of fusion for water in each of the systems of measure listed in learning activity l-d-3 above.

e) specific latent heat of vapourization

1) Explain the meaning of the temri *'specific latent heat of vapourization'.*

2) Write an equation for the term *'specific latent heat of vapourization'.*

3) List the units of specific latent heat of vapourization in the S.I. metric, C.G.S. metric, "old" M.K.S. metric and Imperial systems of measure.

4) State the value of the specific latent heat of vapourization for water in each of the

systems listed in learning activity l-e-3 above.

f) method of mixtures

1) Explain what is meant by the concept of *'method of mixtures'.*

2) Write the main equation used to solve problems involving the *'method of mixtures'.*

3) Solve the example problems as presented in class dealing with *'sensible heat, latent heat of fusion', 'latent heat of vapourization'* and *'heat loss/heat gain'.*

4) Review chapter 13 sections 13.2, 13.3, 13.4, 13.5 and 13.8 and solve the problems as assigned from these sections of the text book.

II) FLUID STATICS AND DYNAMICS

a) pressure

1) Write the general equation for the term *'pressure'.*

2) List the units used to measure pressure in the S.I. metric and the Imperial system of measurement.

3) Identify the relationships that exist among the various units of pressure measurement including: pounds per square inch, kilopascals, newtons per square metre, atmospheres, millibars, inches of mercury, centimetres of mercury, millimetres of mercury, feet of water and metres of water.

b) Pressure at a depth in a liquid

1) Write the two equations used to determine the pressure exerted by a column of liquid of known density and depth beneath the surface.

2) Discuss the relationship that exists, if it exists at all, between the pressure at a given depth in a given liquid and the shape of the containing vessel.

c) Pascal's law

1) Write a verbal statement of Pascal's law and demonstrate an understanding of the law by applying it to examples presented in class.

2) Solve example problems as presented in class involving applications of Pascal's law to hydraulic presses, hydraulic jacks, hydraulic brakes, etc..

d) Archimedes' principle

1) Demonstrate an understanding of the cause of the force of buoyancy. Do so by developing the relationship that exists between the buoyant force acting on an object, either submerged or floating, and the weight of the displaced liquid.

2) Write a verbal statement of *'Archimedes'principle'an6* demonstrate an understanding of the principle by applying it to examples as presented in class.

e) fluid flow

1) Discuss what is meant by the terms *'laminar flow'and 'turbulent flow'.*

2) Write the equations for *'volumetric flow rate', 'mass flow rate'* and *'weight flow* rate'and indicate clearly the meaning of each of the terms in each of the equations.

3) Write a verbal statement of the *'Continuity Principle'* and In your own words explain, in simple terms, the implications of this principle.

4) Write a mathematical statement (an equation) for the *'Continuity Principle'* and solve simple problems involving the flow of an incompressible fluid through a pipe having varying diameters.

5) Write a verbal statement for *'Bernoulli's principle'and* discuss several applications of Bernoulli's principle including the automobile carburetor, an aircraft wing and a baseball pitcher's "curve ball".

6) Write a mathematical statement (an equation) for *'Bernoulli's principle'.* Indicate what each of the *quantities* in the equation represents, the proper units for each of the *terms* in the equation and the rational for each of the terms having these units,

7) Read chapter 12 of the reference text.

8) Answer the questions and solve the problems as assigned from chapter 12 of the reference text.

9) Solve the example and supplementary problems as presented in class dealing with the flow of an incompressible fluid through a pipe having varying diameters and changing elevations. The relationships between *pressure, velocity, elevation* and *frictional losses* are determined by applying *Bernoulli's energy equation.*

III) THE GAS LAWS

a) Bovle's gas law

1) Write a verbal statement of *'Boyle's gas law'.*

2) Write a mathematical statement (an equation) of *'Boyle's gas law'.*

3) Explain what is meant by the terms *'gauge pressure'* and *'absolute pressure'.*

4) Write the equation that interrelates the terms *'gauge pressure', 'absolute pressure'and 'atmospheric pressure'.*

5) List at least a half dozen equivalent expressions for what is known as *'standard atmospheric pressure'.*

6) Solve the example problems as presented in class dealing with the relationship between the *volume* and the *absolute pressure* for a given mass of a gas maintained at a *constant temperature.*

b) Charles' gas law

1) Write a verbal statement of *'Charies'gas law'.*

2) Write a mathematical statement (an equation) for *'Charies' gas law'.*

3) Recall from learning activity lX-c-3 from semester one physics, PHY100, the relationship that exists between the *Celsius* and the *Celsius absolute* temperature scale known as the *Kelvin scale* and the relationship that exists between the *Fahrenheit* and the *Fahrenheit absolute* temperature scale known as the *Rankine* scale.

4) Solve the example problems presented in class dealing with the relationship that exists between the *volume* and the *absolute temperature* for a fixed mass of gas held at a *constant pressure.*

c) Gav-Lussac's gas law

1) Write a verbal statement of *'Gay-Lussac's gas law'.*

2) Write a mathematical statement (an equation) for *'Gay-Lussac's gas law'.*

3) Solve the example problems as presented in class dealing with the relationship that exists between the *absolute pressure* and the *absolute temperature* of a fixed mass of gas held at a *constant volume.*

d) the general gas law

1) Write an equation for the *'general gas law'* indicating clearly the meaning of all terms.

2) Solve the example problems presented in class dealing with the relationships that exist between the *volume,* the *absolute temperature* and the *absolute pressure* for a gas of constant mass.

3) Read chapter 14 of the reference text.

4) Answer the questions and solve the problems as assigned from chapter 14 of the reference text.

iV) THERMODYNAMICS

a) heat and work

1) Recall from semester one physics, PHY100, the definition for the concept of *'work*.*

2) Recall from semester one physics, PHY100, the equation for the concept of *'worl^.*

3) Explain how *'worl^* may be converted into *'heat.*

4) Explain how *'heat* may be converted into 'ivor/c".

5) Write a definition for a *'heat engine* and list several examples of *'heat engines'.*

***b)* the first law of thermodynamics**

1) Write a verbal statement of the *'first law of thermodynamics'.*

2) Write an equation for the *'first law of thermodynamics'* indicating clearly the meaning of all terms.

c) the second law of thermodynamics

1) Write a verbal statement of the *'second law of thermodynamics'.*

***d)* heat engines**

1) Discuss the consequences of the first and second laws of thermodynamics as they pertain to *'heat engines'.*

2) Write the equation for the *'efficiency"* of a heat engine in terms of the quantities of heat absorbed and released by a heat engine operating in a *'cyclic process'.*

3) Explain what is meant by an *'ideal heat engine'.*

4) Write the equation used to determine the *'efficiency'* of an 7dea*/ heat engine'* in terms of the temperatures of the *hot and cold 'reservoirs'.*

5) Solve the example problems as presented in class dealing with heat engines.

e) refrigeration

1) Discuss the consequences of the first and second laws of thermodynamics as they pertain to *'refrigeration units'.*

2) Write the equation for the *'coefficient of performance'* of a refrigeration unit in terms of the quantities of heat absorbed and released by the unit operating in a *'cyclic process'.*

3) Explain what is meant by an 7dea*/ refrigeratof.*

4) Write the equation used to determine the *'coefficient of performance'of* an *'ideal'* refrigeration unit in terms of the temperatures of the hot and cold reservoirs.

5) Solve the example problems as presented in class dealing with refrigeration units.

f) heat pumps

1) Explain what a *'heat pump'* is and in general terms describe how it works.

2) Solve the example problems as presented in class dealing with *'heat pumps'.*

V) MECHANICAL PROPERTIES OF SOLIDS

a) elasticity

1) Define what is meant by an *'elastic*^ body.

2) List a number of examples of *'elastic bodies'.*

3) List a number of examples of *'inelastic bodies'.*

b) Hooke's law

1) Write a verbal statement of Hooke's law as it pertains to springs being stretched or compressed.

2) Write a mathematical statement (an equation) of Hooke's law as it pertains to springs being stretched or compressed.

c) 'stress' and 'strain' - Young's modulus of elasticity

1) Describe what is meant by: *'tensile stress', 'compressive stress'* and *'shearing stress'.*

2) Explain what is meant by *'stress'* in a general sense and write an equation for *'stress'.*

3) List the proper units for stress in each of the S.I. metric and Imperial systems of units.

4) Describe what is meant by *'strain'* in a general sense.

5) For each of *'tensile strain', 'compressive strain'* and *'shearing strain'* write equations including diagrams showing the meaning of each of the terms.

6) Explain what is meant by the term *'elastic limit.*

7) Explain what is meant by the term *'ultimate strength'.*

8) Write a verbal statement and a mathematical statement of *'Hooke's law"* in it's most general form.

9) Explain what is meant by *'Young's modulus'* and state the units of Young's modulus in each of the S.i. metric and Imperial systems of units.

10) Solve the example problems as presented in class involving applications of *'stress', 'strain'* and *'Young's modulus'.*

d) shear modulus

1) Explain what is meant by *'shear modulus'* and state the units of *'shear modulus'* in each of the S.I. metric and Imperial systems of units.

2) Write an equation for *'shear modulus'* and include a diagram showing the meaning of each of the terms.

e) bulk modulus

1) Explain what is meant by the term *'bulk modulus'* and state the units of *'bulk modulus'* In each of the S.I. metric and Imperial systems of units.

2) Write an equation for *each of 'bulk modulus*, 'bulk stress'* and *'bulk strain'.*

***f)* other physical properties of solids - in particular "metals"**

1) Write definitions for each of the following properties of metals: (i) *'hardness',* (11) *'ductility,* (ill) *'malleability* and (iv) *'conductivity.*

2) Solve the problems as handed out on problem sheets dealing with *'stress', 'strain'and 'moduli of elasticity.*

3) Read chapter 11 of the reference text pages 264 to 275, sections 11.1 and 11.2.

4) Solve the problems as assigned from chapter 11 of the reference text.

VI) STATIC ELECTRICITY

a) electric charges

1) List the three major components of the *'atom'* and indicate the relative mass and the charge carried by each.

2) Describe the model of the atom known as the *'planetary model*'. Be certain to include in your description the terms *'nucleus'* and *'orbits'.*

3) Describe how it is possible to charge a pith bail with a *'positive charge'* by *'conduction'.*

4) Describe how it is possible to charge a pith ball with a *'negative charge'* by *'conduction'.*

b) induction

1) Describe how it is possible to charge a *'gold leaf electroscope'* with a *'negative charge'* by the process known as *'induction'.*

2) Describe how it is possible to charge a *'gold leaf electroscope'* with a *'positive charge'* by the process known as *'induction'.*

3) Write the law that describes the attraction and repulsion of "like" and "unlike" charges.

4) Describe the operation of the *"van de Graaff generator".*

c) Coulomb's law

1) Explain what is meant by the unit of electrical charge known as a *'coulomb'.*

2) Write a verbal statement of *'Coulomb's Law of Electrostatics'.*

3) Write a mathematical statement (an equation) of *'Coulomb's Law of Electrostatics'.*

d) electric fields

1) Describe what is meant by and give several examples of *'electric fields'.*

2) Briefly explain some of the many practical applications of electric fields as used in electronics and elsewhere. Some examples might include, for example: an ink-jet printer, a television picture tube and a capacitor.

3) Read chapter 16 in the reference text.

4) Answer the questions and solve the problems as assigned from chapter 16 in the reference text. ^^ ^^

Vin DIRECT CURRENT ELECTRICITY

a) simple circuits

1) Describe, in basic terms, what is meant by the term *'direct current* as opposed to *'alternating current.*

2) Explain what is meant by an *'electric circuit,* included in your explanation should be the terms *'source', 'load* and *'conductor".*

3) Explain what is meant by the terms *'electric potential energ/* or *'difference in potential'* or *'electromotive force'* or *'voltage'.*

4) List several examples of *'potential difference'.*

5) Write the equation for *'potential difference'* or *'emf.*

6) State the unit of *'emf* and describe what it is in terms of the unit of 'wor/c* (the *'joule')* and the unit of *'charge'* (the *'coulomb').*

7) Explain what is meant by the term *'electric current.*

8) State the unit of *'electric current* and describe what it is in terms of the unit of *'charge'* (the *'coulomb')* and the unit of *'time'* (the *'second).*

9) Explain what is meant by the term *'electrical resistance'.*

10) State the unit of *'electrical resistance'.*

11) Write a mathematical equation for the *'electrical resistance'* of a given conductor in terms of it's *'resistivity,* it's length and it's cross-sectional area.

b) Ohm's Law

1) Write a verbal statement of *'Ohm's law'.*

2) Write a mathematical statement (an equation) for *'Ohm's law'.* Indicate the proper abbreviations for each of the terms in the equation and the proper units for each of the terms in the equation.

3) Solve problems as assigned in class dealing with Ohm's law.

c) Series Circuits

1) Describe what is meant by a *'series circuit.*

2) Wr'fte the equations which are used to determine (i) the *'current,* (ii) the *'emf* and (iii) the *'total resistance'* for a simple *'series circuit.*

3) Solve example problems as introduced in class dealing with simple series circuits.

d) Parallel Circuits

1) Describe what is meant by a *'parallel circuit.*

2) Write the equations which are used to determine (i) the *'total current,* (ii) the *'voltage'* across each resistor, (iii) the *'emf* and (iv) the *'total resistance'* for a simple *'parallel circuit.*

3) Solve the example problems as introduced in class dealing with simple parallel circuits.

e) Series-Parallel Circuits

1) Solve the example problems as introduced in class dealing with *'series-parallel circuits'.*

2) Read chapter 17 in the reference text. Answer the questions and solve the problems as assigned from the chapter.

f) **Cells in Series and in Parallel**

1) For a number of battery cells connected in *'series'* write the equations that indicate (i) the *'current* in the circuit; (11) the *'internal resistance'* of the *'battery* in terms of the *'internal resistance'* of the *'cells';* and (Ill) the *'emf* of the *'batter/* In terms of the *'emf* of the *'cells'.*

2) For a number of battery cells connected in *'parallel',* write the equations that indicate (i) the *'total current* in the *'batter/* in terms of the *'individual currents'* in the *'cells';* (il) the *'internal resistance'* of the *'battery* in terms of the *'internal resistance'* of one of the *'cells';* and (iii) the *'emf* of the battery In terms of the *'emf* of the *'cells'.*

3) Solve the example problems as presented in class dealing with the *'total current,* the *'internal resistance'* and the *'emf'* of *'batteries'* of *'cells'* connected in *'series'* and in *'parallel* \

Q) **electrical power**

1) Recall from PHY100 the definition of *'power".*

2) Recall from PHY100 the equation for *'power".*

3) Recall from PHY100 the unit of *'power".*

4) Write the <u>three</u> equations for *'electrical power"* In terms of: *'voltage'* and *'current, 'voltage'* and *'resistance',* and *'current* and *'resistance'.*

5) Recall from PHY100 the definition of *'energy.*

6) Write the unit most commonly used to express the amount of *'electrical energy* consumed by a household or industry and billed by the power company.

7) Solve the example problems as introduced in class dealing with *'electrical power"* and *'electrical energy* consumed.

8) Read chapter 18 in the reference text. Answer the questions and solve the problems as assigned from the chapter.

Method of Assessment:

Your final grade in PHY118 will be determined on the basis of four tests to be administered during the semester. Each test will examine your knowledge of a number of topics and will be administered within one week of completing those topics. The topics covered in each of the four unit tests are as follows:

Test #1——Topic Number 1
Topic Number II

Test #2——Topic Number III
Topic Number IV

Test #3——Topic Number V

Test #4——Topic Number VI
Topic Number VIi

The four tests are of equal weight (i.e. Each of the four tests is worth 25% of your final grade.) As a result, *provided you have received a passing grade on each of the unit tests,* your final grade will simply be an average of your four test results. In order to obtain your letter grade the following percentage-letter grade equivalents will be used:

A+ : 90% -100% (Consistently outstanding achievement)

A : 80% - 89% (Outstanding achievement)

B : 70% - 79% (Above average achievement)

C : 60% - 69% (Satisfactory or acceptable achievement)

X or R: 0% - 59% (Incomplete or Repeat)

If your final average is below 59%, or if you have received a failing grade in one or more of the unit tests, whether you receive an X (Incomplete) or an 'R' (Repeat) grade is entirely at the teacher's discretion. The decision will be based upon your final average (e.g., A grade such as 32% would result in an 'R' grade while an average such as 54% might result in an 'X' grade.); your attendance during the semester; your attitude while in the classroom; your perceived level of effort during the semester; etc..

In any case, should you find yourself with an 'X' grade at the end of the semester, in order to upgrade your mark to a passing grade you will be required to write a *make-up examination covering the entire course content*\ Should you receive a passing grade on the make-up examination (60% or higher) your 'X' grade will be upgraded. The best you can do after receiving an X grade as a result of a failing average is a *C'. If you were required to write the make-up examination as a result of having failed or missed one test, you may substitute the exam result for this test result.

Prior to administering any test, you will be notified a full week in advance. Should you, for any reason, not be able to be in attendance on a day for which a test has been scheduled, it is your responsibility to notify the teacher prior to the test! *If your reasons are acceptable, a* date will be set during which you may write a *substitute* test for the one you have missed.

Notes to Students:

a) **Attendance** and **participation** are **critical** to the student's success in this course.

b) The course outline as detailed on pages 3 to 14 and summarized on page 3 lists the sub-topics to be covered under each of the seven main topic headings. Some sub-topics may be deleted from the outline at the discretion of the teacher and/or others may be introduced. In other words, ***your instructor*** *reserves* ***the right to modify the course as he/she deems necessary in order to meet the needs of the studentsi***

PRilVIARY RESOURCES

Ewen. Nelson and Schurter. **PHYSICS FOR CAREER EDUCATION. Sixth edition.** Regents/Prentice Hall Publishing Company, 1998. ISBN 0-13-692823-4

ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY

Book Section

You will find the college's collection of physics books on the second floor of the college library. They are located on the shelves under the Call Number QC.

Periodical Section

Audiovisual Section

PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the teacher.

SPECIAL NOTES:

Students with special needs (eg. physical limitations, visual impairments, hearing impairments, learning disabilities, etc.) are encouraged to discuss required accommodations confidentially with the instructor.