SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

Sault College

COURSE OUTLINE

COURSE TITLE: ***PHYSICS***

CODE NO. : ***PHY 125-4*** **SEMESTER:** **ONE**

PROGRAM: ***AVIATION TECHNOLOGY - FLIGHT***

AUTHOR: ***GEOFFREY N. DISANO***

DATE: **August 2004** **PREVIOUS OUTLINE DATED:** **June 2001**

APPROVED:

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DEAN **DATE**

TOTAL CREDITS: **FOUR**

PREREQUISITE(S): ***None, although, grade 12 physics is highly recommended!***

HOURS/WEEK: **FOUR**

II COURSE DESCRIPTION:

The intention of this course is to provide both a review of, and a more in depth study of many of the concepts of applied physics introduced in secondary school physics curricula. An attempt will be made to limit the topics to those which should prove to be relevant to the aviation flight student.

II LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

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

1. In his/her own words write definitions for the concepts introduced;
2. Answer questions requiring a knowledge of the concepts presented;
3. Respond to questions requiring extrapolation of the course content;
4. Solve problems requiring an understanding of the course theory;
5. Apply the knowledge to other courses which are “physics based”.

III TOPICS TO BE COVERED:

		Approximate Time Frames (Optional)
1.	INTRODUCTION and MATHEMATICAL CONCEPTS	8 hours
2.	KINEMATICS and DYNAMICS	14 hours
3.	WORK, ENERGY, IMPULSE and MOMENTUM and ROTATIONAL KINEMATICS	14 hours
4.	MECHANICAL PROPERTIES of SOLIDS, LIQUIDS and GASES	14 hours
5.	TEMPERATURE and HEAT	14 hours
6.	WAVE MOTION and SOUND	(See VIII – Special Notes)

IV. LEARNING ACTIVITIES

I INTRODUCTION and MATHEMATICAL CONCEPTS

a) mathematics of basic physics

1) Review the mathematical concepts as presented in chapter 1 of the text book.

b) units of measurement

1) List the three most commonly used systems of units in use in science and engineering:
   i) the *S.I. metric system*;
   ii) the "old" *C.G.S. metric system*;
   iii) the *Imperial system of units* (the *British Engineering system* and the *United States Customary system*).

c) 'base' quantities and 'base' units

1) Define '*base quantities*' and list the 7 *base quantities*.

2) List the 3 "most common" *base quantities*.

3) State the units and the proper abbreviation for the 3 most common *base quantities* in each of the three systems of units of I – b) – 1) above.

4) Define '*derived quantities*' and list at least a dozen examples of *derived quantities*.

d) S.I. metric prefixes and their abbreviations

1) List the S.I. metric prefixes along with their proper abbreviations and mathematical meanings in descending order from '*tera*' to '*femto*'.

2) Set up tables of metric *length measurement*, *area measurement*, "*dry*" *volume measurement*, "*fluid*" *volume measurement*, and *mass measurement*. Each table will illustrate the unit; its proper abbreviation and its meaning for the prefixes from '*kilo*' to '*milli*'.

3) State 2 conversion factors used to convert from "*dry*" *volume measurement* to "*fluid*" *volume measurement* in the S.I. metric system.

e) 'derived' quantities and 'derived' units

1) Recall the definition of *derived quantities* from I – c) – 4) above.

2) List at least a dozen examples of derived quantities as in I – c) – 4) above. For each of these examples write the proper units along with the proper abbreviations in both the *S.I. metric system* and the *Imperial system* of units.

f) conversion of units of measure

1) Given access to the proper conversion factors convert units of measurement in the *S.I. metric*, *C.G.S. metric* and the *Imperial systems* of measurement. Recall the method of conversion that involves '*multiplying by ratios equal to 1'*.

g) significant figures and **h) 'accuracy' and 'precision'**

1) Explain what is meant by an '*exact number*'.

2) Explain what is meant by an '*approximate number*'.

3) Explain what is meant by the term '*accuracy*' of a measurement.

4) Explain what is meant by the term '*precision*' of a measurement.

5) Discuss the difference between the two terms '*precision*' and '*accuracy*' and give examples of measurements having various degrees and combinations of *accuracy* and *precision*.

6) List the 6 rules for determining whether a digit in a measurement is '*significant*' or not.

7) Determine the *accuracy* and the *precision* of any given measurement.

8) State the rule used to determine the *accuracy* of the *product* or *quotient* of *measurements* which are multiplied or divided.

9) State the rule used to determine the *precision* of the *sum* or *difference* of *measurements* which are added or subtracted.

i) 'vector' and 'scalar' quantities

1) Recall the definition of '*scalar quantities*'.

2) List at least 10 examples of *scalar quantities*.

3) Recall the definition of '*vector quantities*'.

4) List 6 examples of *vector quantities*.

5) Write a definition for '*force*' incorporating *Newton's first law of motion* to expand upon the definition.

6) Recall that *force* is a *vector quantity*.

7) Write a definition for '*resultant force*'.

8) By means of the '*parallelogram method*' of vector addition determine the *resultant* of two vectors using both a *graphical* and a *mathematical approach*.

9) By means of the '*polygon method*' of vector addition determine the *resultant* of two or more *vector quantities*.

10) By means of the '*method of components*' calculate the *resultant* of two or more *vector quantities*.

11) Read chapter 1 of the reference text.

12) Answer the questions and solve the problems as presented from chapter 1 of the reference text.

II KINEMATICS and DYNAMICS

a) 'distance' and 'displacement'

1) Write a definition for the term '*distance*'.

2) Write a definition for the term '*displacement*'.

3) Recall that *distance* is an example of a *scalar quantity* while *displacement* is an example of a *vector quantity*.

b) 'speed' and 'velocity'

1) Write a definition for the term '*speed*'.

2) Write a definition for the term '*velocity*'.

3) Recall that *speed* is an example of a *scalar quantity* while *velocity* is an example of a *vector quantity*.

4) Solve problems that illustrate the distinction between the terms '*distance*' and '*displacement*' and the terms '*speed*' and '*velocity*'.

5) Explain what is meant by the term '*uniform motion*'.

6) Explain what is meant by the term '*non uniform motion*'.

7) Write the equations for '*average speed*' and '*average velocity*'. Illustrate how, if possible, each may be determined given a '*displacement versus time*' curve.

c) <u>acceleration</u>

1) Write a definition for the term '*acceleration*'.

2) For '*uniform acceleration*' indicate how the *acceleration* may be determined from a given '*velocity versus time curve*'.

d) <u>equations for 'uniformly accelerated motion'</u>

1) List the 4 equations for '*uniformly accelerated motion*'.

2) Solve the sample problems dealing with *uniformly accelerated motion* as introduced in class.

e) <u>the 'acceleration due to gravity' – "free fall"</u>

1) Explain how the '*acceleration due to gravity*' is dependant upon the *size*, *mass* and '*density*' of a body <u>*in the presence of air resistance*</u> and demonstrate how the '*terminal velocity*' of a given body falling in air may be altered.

2) State the values for the *acceleration due to gravity* <u>*in the absence of air resistance*</u> in each of the *S.I. metric*, *C.G.S. metric* and *Imperial systems* of measure.

3) Solve example problems as presented in class dealing with the *acceleration due to gravity*.

4) Read chapter 2 of the reference text.

5) Answer questions and solve problems as assigned from chapter 2.

f) <u>projectile motion</u>

1) Describe what is meant by the term '*projectile*' and cite the difference between a '*projectile*' and a '*missile*'.

2) Using the equations of uniformly accelerated motion of II – d) – 1) above, develop 6 equations describing the *motion of a projectile in the absence of air resistance*.

3) Solve example problems as presented in class dealing with *projectile motion*.

4) Read chapter 3 of the text book.

5) Answer the questions and solve the problems as presented from chapter 3 of the reference text.

g) <u>forces</u>

1) Recall the definition of '*force*' from learning activity I –i) – 5) above.

2) State the units of *force* in each of the *S.I. metric, C.G.S. metric* and *Imperial systems* and write the proper abbreviations for each.

h) <u>Newton's first law of motion – the 'law of inertia'</u>

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

i) <u>Newton's second law of motion</u>

1) Write a verbal statement of '*Newton's second law of motion*'.

2) Write a mathematical statement (an equation) of '*Newton's second law of motion*'. Indicate the proper units for each of the variables involved in each of the *S.I. metric, C.G.S. metric* and *Imperial systems* of measure.

j) <u>Newton's third law of motion</u>

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

k) <u>types of forces</u>

1) Describe what is meant by the term '*fundamental force*'.

2) List the three types of *fundamental forces* presently known.

3) Explain what is meant by the term '*non fundamental force*'.

4) List at least three examples of *non fundamental forces*.

l) <u>the force of gravity</u>

1) Write a verbal statement and a mathematical statement (an equation) for '*Newton's law of Universal Gravitation*'.

m) <u>the distinction between 'mass' and 'weight'</u>

1) Write a definition for the concept of '*mass*'.

2) Write a definition for the concept of '*weight*'.

3) Identify clearly the distinction between the two quantities '*mass*' and '*weight*'.

4) Write the equation that relates the quantities *mass* and *weight* at a given location given the value of the *acceleration due to gravity* at that location.

5) Recall the values of the *acceleration due to gravity* in each of the three systems of measurement from learning activity II – e) – 2) above.

6) Given the *mass* of a body determine its *weight* on the surface of the Earth.

7) Given the *mass* of a body on the Earth's surface determine its *mass* at any other location in the universe.

8) Given the *weight* of a body on the Earth's surface, determine the *mass* of the body on the Earth's surface and at any other location in the universe.

n) <u>the 'normal force' and Newton's Third Law of Motion</u>

1) Explain what is meant by the '*normal force*' and describe the relationship that exists between the *normal force* and the *weight* of an object at rest on a horizontal surface.

2) Explain what is meant by the term '*apparent weight*' and indicate how it is different from the '*weight*' of an object that is being accelerated either vertically upward or vertically downward.

3) Write the equation that relates the *apparent weight* and the *true weight* for an object that is being accelerated vertically with a given *acceleration*.

o) <u>static and kinetic frictional forces</u>

1) Describe the relationship that exists between the *applied force* and the *force of friction* for an object, initially at rest, being acted upon by an *applied force* which increases from zero to a value at which the object begins to slide across the surface. Assume that the surface is horizontal and that there is no vertical force being applied to the object.

2) Graph the relationship as described in the learning objective above by plotting the *force of friction* as a function of the *applied force*. Be certain to illustrate the two regions that exist on the resulting graph – namely the '*static region*' and the '*kinetic region*'.

3) On the graph above indicate the two values of the *friction force* known as, respectively, the *maximum force of static friction* and the *force of sliding friction.*

4) Write the equation that interrelates the *maximum force of static friction*, the *normal force* and the quantity known as the '*coefficient of static friction*'.

5) Write the equation that interrelates the *force of sliding friction*, the *normal force* and the quantity known as the '*coefficient of kinetic friction*'.

6) State the range of values for the *coefficients of friction.*

p) <u>the tension force</u>

1) Explain what is meant by the '*force of tension*' that exists in a rope, cable, wire or rod being used to support an object against the force of gravity or pull on an object to accelerate it.

q) <u>static equilibrium problems</u>

1) Write a definition for the term '*static equilibrium*'.

2) Explain the meaning of the term '*concurrent forces*'.

3) Write the two equations that apply when dealing with a number of '*concurrent*', '*coplanar forces*' that are known to be in '*static equilibrium*'.

4) Solve problems involving systems of '*concurrent, coplanar forces in equilibrium*'.

r) <u>applications of Newton's laws of motion</u>

1) Recall from learning activities II – h), i) and j), the statements of Newton's first, second and third laws of motion and the mathematical statement of Newton's second law of motion.

2) Solve the problems introduced in class dealing with non-equilibrium applications of Newton's laws of motion.

3) Read chapter 4 of the text book.

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

III <u>WORK, ENERGY, IMPULSE and MOMENTUM and ROTATIONAL KINEMATICS</u>

a) <u>work</u>

1) Write a definition for the concept of '*work*'.

2) Recall the equation for *work* in it's most general form.

3) Write a definition for the concept of '*energy*'.

4) List the proper units of *work* and *energy* in each of the *S.I. metric* and *Imperial systems* of measure.

b) <u>kinetic energy</u>

1) Write a definition for the concept of '*kinetic energy*'.

2) Recall the equation for '*kinetic energy*'.

c) <u>gravitational potential energy</u>

1) Write a definition for the term '*gravitational potential energy*'.

2) Recall the two equations for '*gravitational potential energy*'.

d) <u>conservation of mechanical energy</u>

1) Write a verbal statement for the '*law of conservation of mechanical energy*'.

2) Write a mathematical statement of the relationship that exists between the *work done on a system by external forces* and the *change in energy* of the system that results.

3) Solve example problems as presented in class dealing with *work, kinetic energy, gravitational potential energy* and the *law of conservation of mechanical energy*.

e) power

1) Write a definition for the term '*power*'.

2) Recall two equations for calculating '*power*'.

3) List the proper units of *power* in each of the *S.I. metric* and *Imperial systems* of measure.

4) State the relationship between the unit known as the '*horsepower*' and the *Imperial unit* of power.

5) State the relationship between the unit known as the '*horsepower*' and the '*watt*' and the '*kilowatt*'.

6) Solve the example problems as presented in class dealing with *power*.

f) the conservation of energy

1) Write a verbal statement of the '*law of conservation of energy*'.

2) Explain briefly the relationship that exists between *mass* and *energy*.

3) Answer questions and solve problems as assigned from chapter 6.

g) efficiency

1) Explain with the aid of a diagram what is meant by the term '*efficiency*'.

2) Write a generalized equation for the term '*efficiency*'.

h) mechanical advantage (actual)

1) Explain with the aid of a diagram what is meant by the concept of a '*simple machine*'.

2) Write a definition for the term '*(actual) mechanical advantage*'.

3) Write the equation for '*(actual) mechanical advantage*'.

i) <u>velocity ratio (ideal mechanical advantage)</u>

1) Write a definition for the term '*velocity ratio*' or '*ideal mechanical advantage*'.

2) Write the equation for '*velocity ratio*' or '*ideal mechanical advantage*'.

j) <u>some simple machines</u>

1) Apply the concepts of learning activities III - g), h) and i) above to problems involving '*simple machines*' such as: the '*lever*', the '*inclined plane*', the '*screw*', the '*wheel & axle*', '*pulleys and pulley systems*', '*gears and gear systems*' and the '*hydraulic jack*'.

2) Solve the example problems as presented in class dealing with simple machines.

3) Read the handout distributed in class dealing with simple machines.

4) Answer the questions and solve the problems pertaining to simple machines on the handout distributed in class.

k) <u>momentum</u> , l) <u>impulse</u> and m) <u>conservation of momentum</u>

1) Read and be held responsible for the contents of chapter 7 of the reference text dealing with '*momentum*', '*impulse*' and the '*conservation of momentum*'.

2) Recall that *impulse* is a *vector quantity.*

3) Write a definition for the concept of '*impulse*'.

4) Write an equation for the concept of '*impulse*'.

5) Recall that *momentum* is a *vector quantity.*

6) Write a definition for the concept of '*momentum*'.

8) Write an equation for the concept of '*momentum*'.

9) Explain the relationship that exists between *impulse* and *momentum* and write both verbal and mathematical statements of the '*impulse-momentum theorem*'.

10) Write a verbal statement of the '*law of conservation of linear momentum*'.

11) Solve the example problems as presented in class involving the principles of '*impulse*' and '*momentum*' in both one and two dimensions.

12) Apply the equation relating '*thrust*', the '*velocity of the exhaust gases relative to the rocket motor*' and the '*time rate of change of fuel mass*' to a simplified analysis of rocket propulsion problems.

13) Answer the questions and solve the problems as assigned from chapter 7 of the text.

n) <u>angular measurement</u>

1) Recall, with the aid of a diagram, the meaning of and the relationships between the various units of angular measurement: the '*revolution*', the '*degree*', '*minute*' & '*second*' and the '*radian*'.

2) Write the definition for the concept of '*angular displacement*'.

o) <u>angular velocity</u>

1) Write the definition for the term '*average angular velocity*'.

2) Write the equation for the term '*average angular velocity*'.

3) State the proper units for the term '*angular velocity*'.

p) <u>angular acceleration</u>

1) Write the definition for the term '*average angular acceleration*'.

2) Write the equation for the term '*average angular acceleration*'.

3) State the proper units for the term '*angular acceleration*'.

q) <u>equations of rotational kinematics</u>

1) Recall the four equations for *uniformly accelerated linear motion* from learning activity II – d) –1). Using these equations as a pattern, write the four equations for *uniformly accelerated angular motion*.

2) Solve the problems as presented in class involving *uniformly accelerated angular motion*.

r) relationship between *angular motion* and *linear motion*

1) Develop the mathematical relationship between '*angular displacement*' and '*linear displacement*' for a point on a rotating body at a given distance from the point of rotation.

2) Develop the mathematical relationship between '*angular velocity*' and '*linear velocity*' for a point on a rotating body at a given distance from the point of rotation.

3) Develop the mathematical relationship between '*angular acceleration*' and '*linear acceleration*'. Do so for a point on a rotating body, at a given distance from the point of rotation, when the rotating body has a change in *angular velocity* with respect to time.

s) *normal acceleration* or *centripetal acceleration*

1) Write the definition for the term known as '*centripetal acceleration*' or '*normal acceleration*'.

2) Distinguish between the terms '*angular acceleration*' and '*centripetal acceleration*'.

3) State two equations used to calculate the '*centripetal acceleration*', (also known as the '*normal acceleration*'), for a point on a body rotating with a constant *angular velocity* given the distance from the point in question to the *point of rotation*.

t) centripetal and centrifugal forces

1) Explain what is meant by the terms '*centripetal force*' and '*centrifugal force*' and discuss the relationship between the two in terms of *Newton's third law of motion* from learning activity II - j) - 1). You may wish to make reference to *Newton's first law of motion* in your discussion of the meaning of one of the two "*forces*".

2) Answer the questions and solve the problems as assigned from chapter 8 of the reference book.

IV MECHANICAL PROPERTIES OF SOLIDS, LIQUIDS & GASES

a) mass density

1) Write a definition for the term '*mass density*'.

2) Write the equation for the term '*mass density*'.

3) List the proper units for '*mass density*' in each of the *S.I. metric, C.G.S. metric* and *Imperial systems* of units.

b) weight density

1) Write a definition for the term '*weight density*'.

2) Write the equation for the term '*weight density*'.

3) List the proper units for '*weight density*' in each of the *S.I. metric, C.G.S. metric* and *Imperial systems* of units.

4) Write the equation that relates mathematically '*mass density*' and '*weight density*'.

c) specific gravity

1) Write a definition for the term '*specific gravity*'.

2) Write the equation for the term '*specific gravity*'.

3) List the values of the '*mass density*', '*weight density*' and '*specific gravity*' of *pure water* at its temperature of *maximum density*.

d) pressure

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

e) units of pressure measurement

1) List the units used to measure pressure in each of the *S.I. metric* and *Imperial systems* of measure.

2) Identify the relationships that exist among the various units of pressure measurement including: lb/in^2, kPa, N/m^2, atmospheres, mb, in. of Hg, cm of Hg, mm of Hg, ft of H_2O, and m of H_2O.

f) <u>pressure at a depth in a liquid</u>

1) Write the two equations used to determine the pressure exerted by a column of liquid.

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*.

g) <u>atmospheric pressure, absolute pressure and gauge pressure</u>

1) List at least 8 equivalent values for '*standard atmospheric pressure*'.

2) Describe what is meant by the term '*vacuum*' paying particular attention to the distinction between '*<u>partia</u>l vacuum*' and '*<u>tota</u>l vacuum*'.

3) Write a definition for the term '*gauge pressure*'.

4) Write a definition for the term '*absolute pressure*'.

5) Write the equation that relates the terms '*absolute pressure*', '*gauge pressure*' and '*atmospheric pressure*'.

h) <u>Pascal's law</u>

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

i) <u>the hydraulic press</u>

1) Recall from learning activity III – j) – 1) that a '*hydraulic jack*' is an example of a '*simple machine*'.

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

j) <u>Archimedes' principle</u>

1) Demonstrate an understanding of the <u>cause</u> 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 fluid*.

2) Write a verbal statement of *Archimedes' principle* and demonstrate an

understanding of the principle by applying it to examples as presented in class.

3) Solve the problems as presented on problem sheets 1, 2 and 3 dealing with '*hydrostatic pressure*', the problem sheet dealing with *Pascal's law* and the problem sheet dealing with *Archimedes' principle*.

4) Read chapter 11, sections 11.1 to 11.6 in the text book.

5) Answer the questions and solve the problems as assigned from the first part of chapter 11.

k) <u>fluids in motion</u>

1) State the two broad classifications of fluid and list the differences between these two categories of fluid.

2) Discuss what is meant by the terms: '*steady flow*', '*unsteady flow*', '*laminar flow*', '*turbulent flow*', '*viscosity*', '*streamlines*' and '*streamline flow*'.

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

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

5) Write a mathematical statement (an equation) for the '*Continuity Principle*'.

6) Solve simple problems involving the flow of an '*<u>incompressible</u> fluid*' through a pipe having varying diameters along the path of flow.

l) <u>Bernoulli's Principle and Equation</u>

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

2) 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 <u>and</u>

the rational for each of the terms having these units. You will find that there are two equations that are commonly used to represent *Bernoulli's principle*. Although each equation is applicable in any system of units, one equation is more commonly used in the *S.I. metric system* while the other is more commonly used in *Imperial*.

3) Read chapter 11, sections 11.7 to 11.12 in your text book.

4) Answer the questions and solve the problems as assigned from the second half of chapter 11 of your reference text.

5) 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*. See learning objective IV – l) – 2) above.

V TEMPERATURE AND HEAT

a) temperature

1) Read the handout titled 'Historical Sketch on the Nature of Heat'.

2) Discuss what is meant by the term '*thermal energy*'.

3) Write 2 definitions for the concept of '*temperature*'.

b) temperature scales and c) absolute temperature scales

1) List the four most commonly used temperature scales along with the proper abbreviation for each of the '*units of temperature*' on each scale.

2) On each of the temperature scales above, recall the value of each of the following temperatures: the '*boiling point*' of water at standard atmospheric pressure, the '*freezing point*' of water at standard atmospheric pressure, and the temperature known as '*absolute zero*'.

3) State the mathematical relationships that exist between: (i) the '*Celsius*' and the '*Fahrenheit temperature scales*'; (ii) the '*Celsius*' and the '*Kelvin temperature scales*'; and (iii) the '*Fahrenheit*' and the '*Rankine temperature scales*'.

4) Explain what is meant by the concept of '*absolute zero*' making reference to the terms '*temperature*' and '*thermal energy*' in your

explanation.

5) Given a temperature on any of the four temperature scales of learning activity V – b) – 1), convert this temperature to an equivalent value on each of the remaining three temperature scales.

d) <u>heat</u>

1) Explain the meaning of the concept of '*heat*'.

2) Distinguish clearly between the concept of '*heat*' and the concept of '*temperature*' as defined in learning activity V – a) – 3).

e) <u>thermal linear expansion of solids</u>

1) List the 3 factors that determine the amount of '*thermal linear expansion*' of a solid.

2) Explain clearly the meaning of the term '*coefficient of linear expansion*'.

3) Write the equation used to determine the amount of *linear expansion* for a solid subjected to a change in temperature.

4) Solve the example problems as presented in class dealing with *linear thermal expansion of solids.*

f) <u>thermal area expansion of solids</u>

1) List the 3 factors that determine the amount of '*thermal area expansion*' of a solid.

2) Explain clearly the meaning of the term '*coefficient of area* ex*pansion*'.

3) Write the equation used to determine the amount of *area expansion* for a solid subjected to a change in temperature.

4) Discuss the relationship that exists between the '*coefficient of area expansion*' for a solid and the corresponding '*coefficient of linear expansion*'.

5) Solve the example problems as presented in class dealing with *thermal area expansion of solids.*

g) <u>thermal volume expansion of solids</u>

1) List the 3 factors that determine the amount of '*thermal volume expansion*' a solid subjected to a temperature change experiences.

2) Explain clearly the meaning of the term '*coefficient of volume expansion*'.

3) Discuss the relationship that exists between the '*coefficient of volume expansion*' for a solid and the corresponding '*coefficient of linear expansion*'.

4) Write the equation used to determine the *amount of thermal volume expansion* experienced by a solid subjected to a change in temperature.

5) Solve the example problems as presented in class dealing with *thermal volume expansion of solids.*

h) <u>thermal volume expansion of liquids</u>

1) Indicate how one would determine or where one would find the '*coefficients of volume expansion*' for liquids.

2) Solve the problems and answer the questions as assigned from chapter 12 of your text book, dealing with temperature and thermal expansion.

3) Discuss in detail the unusual behaviour of water with regard to its *volume* and *density* as a function of *temperature*. Explain how it is that small northern lakes do not freeze solid during the winter months and, as a result, are able to support aquatic plant, fish and animal life.

i) <u>units of heat measurement</u>

1) List the various units used to measure '*heat content*' and for each unit explain clearly it's meaning or definition.

2) State the relationships that exist between the units of '*heat content*' including: the '*calorie*', the '*kilocalorie*', the '*joule*', the '*B.T.U.*' and the '*therm*'.

j) <u>specific heat capacity</u>

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 each of: 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 V –j) – 3).

k) <u>changes of state</u>

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

2) Write the proper terms 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*.

3) Explain what is meant by the *state* known as a '*plasma*'.

l) <u>specific latent heat of fusion</u>

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

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

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 V – l) – 3) above.

m) <u>specific latent heat of vapourization</u>

1) Explain the meaning of the term '*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 of water* in each of the systems of measure listed in V – m) – 3) above.

5) 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"*.

6) Write the main equation that is used to solve *calorimetry problems*.

7) Answer the questions and solve the problems as assigned from chapter 12 of reference A, dealing with *calorimetry*, and chapter 18 of reference B.

n) <u>methods of heat transfer</u>

1) Read chapter 13 of the reference text and be responsible for it's contents.

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

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

4) Write the equation used to calculate 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.

5) Solve the example problems as presented in class dealing with the equation of learning activity V – n) – 4) above.

6) Describe what is meant by the term '*R-value*' and write the equation that relates the *R-value* to the '*thermal conductivity*' of a material.

7) Describe the means by which the '*thermal conductivity*' of a material may be determined.

8) Explain what is meant by the concept of an '*ideal blackbody*'.

9) Write a verbal statement of the '*Stefan-Boltzmann law of radiation*'.

10) Write a mathematical statement (an equation) for the '*Stefan-Boltzmann law of radiation*' and use the equation to solve example problems as presented in class.

11) Describe several applications that either use *heat transfer methods* to advantage or try to limit the transfer of heat by these methods.

12) Answer the questions and solve the problems as assigned from chapter 13 of the reference text book.

o) <u>Boyle's gas law</u>

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

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

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

p) <u>Charles' gas law</u>

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

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

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

q) <u>Gay-Lussac's gas law</u>

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 presented in class dealing with the relationship between *absolute pressure* and *absolute temperature* for a *fixed mass* of a gas held at a *constant volume*.

r) <u>the general gas law</u>

1) Write an equation for the '*general gas law*' indicating clearly the meaning of each of the variables in the equation.

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

s) <u>the ideal gas law</u>

1) Write a mathematical statement (an equation) for the *ideal gas law*.

2) Explain what is meant by the *universal gas constant* and state its value in the *S.I. metric system* of units.

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

VI WAVE MOTION AND SOUND

a) types of waves

1) Describe what is meant by and give several examples of '*transverse waves*'.

2) Describe what is meant by and give several examples of '*longitudinal waves*'.

3) Explain the meaning of the terms '*compression*', or '*condensation pulse*', and '*rarefaction pulse*' with reference to several examples of *longitudinal waves,* including '*longitudinal waves in a spring*' and '*sound waves*'.

4) Explain with the aid of a diagram how waves on the surface of water may be described as a *combination* of '*transverse*' and '*longitudinal wave motions*'.

b) periodic motion

1) Describe what is meant by and give examples of '*periodic motion*'.

2) Given a graphical representation of a *transverse wave,* indicate what is meant by and write definitions for the terms: '*cycle*', '*amplitude*', and '*wavelength*'.

3) Explain clearly the meaning of the term '*period*' of a *simple harmonic motion.*

4) Explain the meaning of the term '*frequency*' of a *simple harmonic motion.*

5) List the various *units* that may be used to express the *frequency* of a *simple harmonic motion.*

6) Write the equation that describes the relationship between the '*period*' and the '*frequency*' of a *simple harmonic motion*.

7) Write the two equations that may be used to determine the '*speed*' of a wave through a '*medium*'. One equation is in terms of '*speed*', '*frequency*' and '*wavelength*'. The other is in terms of '*speed*', '*period*' and '*wavelength*'.

8) Write the equation that may be used to determine the speed of a small-amplitude wave on a string. This equation is in terms of the *speed of the wave*, the '*linear density*' of the string and the '*tension force*' in the string.

9) Write the equation that relates the *period* of a *simple harmonic motion* of a mass oscillating on the end of a vertical spring to the values of the *mass* of the mass and the '*spring constant*' of the spring.

10) Describe what is meant by the terms '*resonance*' and '*resonant frequency*'.

c) <u>the nature of sound</u>

1) Write a definition for the *<u>physical</u> phenomenon* known as '*sound*'.

2) List the requirements necessary for the *generation* and *propagation* of *sound*.

d) <u>the frequencies of a sound wave</u>

1) State the range of *frequencies* which are audible to the human ear.

2) Explain what is meant by the term '*infrasonic frequencies*'.

3) Explain what is meant by the term '*ultrasonic frequencies*'.

e) <u>speed of sound</u>

1) Write the equation used to determine the speed of sound in air given the air temperature in degrees Celsius.

2) Write the equation used to determine the speed of sound in air given the air temperature in degrees Fahrenheit.

3) Given the temperature of the air in either ^{o}C or ^{o}F calculate the speed of sound in the air using the equations of learning activities VI – e) – 1) and VI – e) – 2) above.

f) <u>loudness and intensity of sound</u>

1) Explain what is meant by the term '*intensity*' of a sound.

2) Write the equation that may be used to determine the '*intensity*' of a sound.

3) Explain what is meant by and give the value of the *intensity* known as the '*threshold of hearing*'.

4) Explain what is meant by and give the value of the *intensity* known as the '*threshold of pain*'.

5) Explain what is meant by the term '*loudness*' of a sound.

6) State the meaning of the unit used to measure the *loudness of a sound*, the '*decibel*'.

7) Write the equation that expresses the *Weber-Fechner law* which is used to express the *loudness of a sound*, in *decibels*, given it's *intensity* in W/m^2.

8) Answer the questions and solve the problems as assigned from chapter 16 of the reference text.

COURSE OUTLINE
(Summarized)

TOPIC NO.	PERIODS	TOPIC DESCRIPTION	REFERENCE
I		**INTRODUCTION and MATHEMATICAL CONCEPTS**	Chapter 1

a) mathematics of basic physics
b) units of measurement
c) '*base quantities*' and '*base units*'
d) S.I. metric prefixes and their abbreviations
e) '*derived quantities*' and 'derived units'
f) conversion of units of measure
g) significant figures
h) '*accuracy*' and '*precision*'
i) '*vector*' and '*scalar quantities*'

II **KINEMATICS and DYNAMICS** Chapters 2,3,4

a) '*distance*' and '*displacement*'
b) '*speed*' and '*velocity*'
c) acceleration
d) equations for 'uniformly accelerated motion'
e) the '*acceleration due to gravity*' – "*free fall*"
f) projectile motion
g) forces
h) Newton's first law of motion – the '*law of inertia*'
i) Newton's second law of motion
j) Newton's third law of motion
k) types of forces
l) the *force of gravity*
m) the distinction between '*mass*' and '*weight*'
n) the '*normal force*' and Newton's third law of motion
o) static and kinetic frictional forces
p) the tension force
q) static equilibrium problems
r) applications of Newton's laws of motion

III **WORK, ENERGY, IMPULSE and MOMENTUM and ROTATIONAL KINEMATICS**

Chapters 6,7,8

a) *work*
b) *kinetic energy*
c) *gravitational potential energy*
d) conservation of mechanical energy
e) *power*
f) the conservation of energy
g) *efficiency*
h) *mechanical advantage (actual)*
i) *velocity ratio (ideal mechanical advantage)*
j) some simple machines
k) *momentum*
l) *impulse*
m) conservation of momentum
n) angular measurement
o) *angular velocity*
p) *angular acceleration*
q) equations of rotational kinematics
r) relationship between angular motion and linear motion
s) *normal acceleration* or *centripetal acceleration*
t) *centripetal* and *centrifugal forces*

IV **MECHANICAL PROPERTIES OF SOLIDS, LIQUIDS and GASES**

Chapter 11

a) *mass density*
b) *weight density*
c) *specific gravity*
d) *pressure*
e) units of pressure measurement
f) pressure at a depth in a liquid
g) *atmospheric pressure*, *absolute pressure*, *gauge pressure*
h) Pascal's law
i) the hydraulic press
j) Archimedes' principle
k) fluids in motion
l) Bernoulli's principle and equation

V **<u>TEMPERATURE and HEAT</u>** Chapters 12,13,14

a) *temperature*
b) temperature scales
c) absolute temperature scales
d) *heat*
e) *thermal linear expansion* of solids
f) *thermal area expansion* of solids
g) *thermal volume expansion* of solids
h) *thermal volume expansion* of liquids
i) units of heat measurement
j) *specific heat capacity*
k) changes of state
l) *specific latent heat of fusion*
m) *specific latent heat of vapourization*
n) methods of heat transfer
o) Boyle's gas law
p) Charles' gas law
q) Gay-Lussac's gas law
r) the general gas law
s) the ideal gas law

VI **<u>WAVE MOTION and SOUND</u>** Chapter 16

a) types of waves
b) periodic motion
c) the nature of *sound*
d) the *frequencies* of a sound wave
e) speed of sound
f) *loudness* and *intensity* of sound

V. REQUIRED RESOURCES/TEXTS/MATERIALS:

1) ***"Reference A" –Cutnell & Johnson***, ***<u>PHYSICS</u>*** **<u>Volume 1</u>, Fifth edition.** John Wiley & Sons, Inc. Toronto. 2001. ISBN 0-471-38717-7
*NOTE: This text is part of a three component package which includes: (1) the text book ***<u>PHYSICS</u>*** **<u>Volume 1</u>**, (2) the Student Solutions Manual and (3) the '*Take Note!*' art notebook of textbook illustrations.

VI. 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

VII. EVALUATION PROCESS/GRADING SYSTEM:

The following semester grades will be assigned to students in post secondary courses:

Grade	**Definition**	*Grade Point Equivalent*
A+	90 – 100%	4.00
A	80 – 89%	
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00

CR (Credit)	Credit for diploma requirements has been awarded.
S	Satisfactory achievement in field /clinical placement or non-graded subject area.
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR	Grade not reported to Registrar's office.
W	Student has withdrawn from the course without academic penalty.

GRADE REQUIREMENTS
PHYSICS PHY 125
(Aviation Technology – Flight)

Your final grade in PHY 125-4 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 tests are as follows:

Test #1 ----- Topic Number I and Topic Number II

Test #2 -----Topic Number III

Test #3 ----- Topic Number IV

Test #4 ----- Topic Number V

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 in each of the four tests*****, your final grade will simply be an average of your four test results.** In order to obtain your letter grade the percentage-letter grade equivalents shown on page 30 will be used.

If your final average is below 50%, ***or*** if you have received a failing grade in one or more of the unit tests, whether you receive an 'X' grade (*Incomplete*) or an 'F' grade (*Fail*) is entirely at the professor's discretion. The decision will be based upon *your final average* (e.g. 32% **would** result in an F grade while 48% **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 (50% 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' grade! If you were required to write the supplemental 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 (*within reason of course*), 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.

VI. SPECIAL NOTES:

Special Needs:
If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your professor and/or the Special Needs office. Visit Room E1101 or call Extension 703 so that support services can be arranged for you.
This of course will not affect Aviation – Flight students due to the nature of the entrance requirements for the program. It may however affect students from outside the Aviation - Flight program who may be taking this course for a credit in another area of study.

Retention of Course Outlines:
It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Plagiarism:
Students should refer to the definition of "academic dishonesty" in *Student Rights and Responsibilities*. Students who engage in "academic dishonesty" will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course/program, as may be decided by the professor or dean. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Course Outline Amendments:
The course outline as *detailed on pages 3 to 27* and *summarized on pages 27 to 29* lists the subtopics to be covered under each of the six main topic headings. Some topics and/or subtopics may be deleted from the outline or given only cursory coverage at the discretion of the course professor and/or others may be introduced. In other words, *the professor reserves the right to modify the course as he/she deems necessary depending on the needs of the student and the availability of resources*.
In addition, topic VI is optional; however, time permitting it will be covered. There is therefore the possibility for some latitude in the grading scheme as detailed on page 31.

Substitute course information is available in the Registrar's office.

Attitude and Conduct specific to the Aviation – Flight Program

Attitude plays an important role in your ability to exercise good judgement. Although attitude is not being graded (except with regard to making a call between granting an 'X' grade over an 'F' grade), it affects your ability to learn as well as your safety as a student and future as a professional pilot. Students who display a strong tendency toward any of the five hazardous attitudes pose a grave risk to themselves and others. For this reason these students will be counseled and put on behavioural contract. If counseling is ineffective, then the student will be withdrawn from the program.

The five hazardous attitudes are identified as Anti-authority, Impulsivity, Invulnerability, Machismo and Resignation. These hazardous attitudes are described in "Human Factors for Aviation – Basic Handbook" on pages 151 and 152.

NOTE: The above two paragraphs were taken from the course outline for *Flight Operations AVT 377-2*. Although more pertinent to an *aviation* course as such than a course in *physics*, since the students taking this course are doing so as part of their Aviation – Flight program there is a certain amount of relevance to this course as well.

Mid Term Grades for Aviation – Flight students

As the aviation – flight student is required to maintain a 'B' average to remain in the program, mid term grades will reflect this requirement by assigning an 'S' (satisfactory) grade only to those students who are maintaining at least a 70% current grade in the course. A 'U' grade (unsatisfactory) will be assigned to students who, at mid term, are carrying a grade of 69% or less. This does not necessarily mean that the student is failing the course at mid term however. Should the student be carrying a 'D' or a 'C' grade at mid term, which of course is a passing grade, he/she will still be given a 'U' reflecting the specific requirements of the aviation – flight program.

VII PRIOR LEARNING ASSESSMENT:

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean's secretary. Students who wish to apply for advanced credit in this course should consult with the professor. Credit for prior learning will be given upon successful completion of the following:

1) A discussion with the professor will determine if the course that the student has previously taken at another *post secondary institution* is sufficiently close in content to warrant consideration. *Credit will not be granted for O.A.C. physics courses!*

2) Given that step (1) above is granted, the student will need to bring the professor an ***official*** *course outline* for the course in question to verify step (1). See **VIII Direct Credit Transfers** below.

3) The student will be required to have available in the registrar's office an ***official*** *transcript* from the *post secondary institution* in question. This transcript will contain the final grade of the course which is being presented to obtain a credit for this course in physics. See **VIII Direct Credit Transfers** below.

4) Given that the student has obtained *at least a* ***'B'*** *standing* in the course in question, a credit for PHY 125 will be granted. *A 'Pass' grade or a 'C' grade will not be accepted for advanced credit standing in this course.*

VIII DIRECT CREDIT TRANSFERS:

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean's secretary. Students will be required to provide an *official* transcript (**not** a photocopy) and an *official* course outline (**not** a photocopy) related to the course in question. Both of these documents must be issued by the university or college at which the course was taken by the student.