SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

SAULT
COLLEGE

COURSE OUTLINE

COURSE TITLE:	Applied Mechanics - Statics		
CODE NO. :	MCH110	**SEMESTER:**	Two
PROGRAM:	Aviation Technology Flight		
AUTHOR:	Douglas McKinnon		
DATE:	Jun 2015	**PREVIOUS OUTLINE DATED:**	Dec 2015
APPROVED:	**Aviation Operations Manager**		**DATE**
TOTAL CREDITS:	4		
PREREQUISITE(S):			
HOURS/WEEK:	4		

For additional information please contact Greg Mapp, Director of Aviation.

(705) 759-2554, Ext. 2865

I. COURSE DESCRIPTION:

The intention of this course is to introduce the student to the fundamental concepts of 'Mechanics - Statics' which should prove useful to the aviation technology flight student. The fundamental concepts are very important as they form the basis for other courses in technology, such as: dynamics, strength of materials, and mechanics of fluids.
Every effort will be made not to dwell on the theory of these concepts, but to stress practical applications through the extensive use of problem solving, and the presentation of the solutions, in a style consistent with standard engineering practice.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

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

1. ***INTRODUCTION***

Using the theorems, laws and functions of both right-angle and non right-angle trigonometry, and an understanding of basic algebra and geometry, solve 'force vector' problems.

Potential Elements of the Performance:

1) Write both a verbal and a mathematical statement of the basic principle known as the *Pythagorean theorem.*
2) Illustrate with a sketch of a right-angled triangle the accepted method of labeling both the sides and the angles of this triangle.
3) Recall the six trigonometric functions and apply these to simple *right-angled triangle* problems to solve for the lengths of unknown sides or the magnitude of unknown angles.
4) Recall both the *sine law* and the *cosine law* and apply these to the solution of triangles which are non-right-angled. Show that for a right-angled triangle the *cosine law* reduces to the *Pythagorean theorem.*
5) Recall the relationships that exist by way of conversion factors between the *S.I. metric* and the *Imperial system of units* for quantities such as length, mass, weight and force. Convert between systems of units using the *method of multiplying by ratios equal to one.*

6) Recall the two main concepts of *dimensional analysis* that an algebraic relationship involving quanties must satisfy.
7) Recall the basic rules of geometry involving: *intersecting straight lines*, *supplementary angles*, *complementary angles*, the relationships between angles when a *straight line intersects two parallel lines*, *interior angles of a triangle*, *similar triangles* and the equations for the *circumference* and the *area of a circle*.

2. ***VECTOR ANALYSIS***

Determine the 'resultants' and the 'equilibrants' of systems of forces both by adding the vector quantities and by adding the vector components.

Potential Elements of the Performance:

1) Define what is meant by a *scalar quantity* and list at least a dozen examples of *scalar quantities*.
2) Define what is meant by a *vector quantity* and list seven examples of *vector quantities.*
3) List the various types of *forces* along with their characteristics and the commonly used units for forces both in the S.I. metric and the Imperial system of units.
4) Describe what is meant by the *resultant* of a system of forces.
5) Describe what is meant by the *equilibrant* of a system of forces.
6) Using the method known as the *parallelogram method*, determine the *resultant* of two vector quantities using both a *graphical* and a *mathematical approach.*
7) Using the method known as the *string polygon method*, determine the *resultant* of two or more vector quantities using a graphical approach.
8) Given a vector quantity superimposed onto an x-, y-coordinate plane, resolve the vector into its two *orthogonal components*, namely its *x-component* and its *y-component.*
9) Determine the *resultant* of two or more vector quantities by the analytical method known as the *method of components.*

3. ***MOMENTS AND COUPLES***

Determine the 'moment' of a force about a given point and axis of rotation.

Potential Elements of the Performance:

1) Define what is meant by the *moment* or *torque* of a force about

a given point of rotation.
2) Write the equation for determining the *moment* or *torque* of a force about a given point of rotation.
3) Calculate the *moment* of a force by:
   (a) multiplying the *total force* by its *perpendicular distance to the point of rotation*; &.
   (b) multiplying *each of the force's components* by their respective *perpendicular distances to the point of rotation.*
4) Determine the *resultant moment* for a system *of moments.*
5) Name the three factors that together constitute what is known as a '*couple*'.
6) Calculate the *moment* of a given *couple.*
7) Replace a given *couple* with an equivalent *couple* at a different location.
8) Analyze the effects of *couples* on a body.

4. ***EQUILIBRIUM OF FORCES IN TWO DIMENSIONS***

Apply the "Three Conditions of Equilibrium" to determine unknown forces in various force systems.

Potential Elements of the Performance:

1) Write the 3 equations that represent the three requirements that must be met for a body to be in a state of '*static equilibrium*'.
2) Explain what is meant by a '*free body diagram*'.
3) List the assumptions or conventions that one must employ when drawing *free body diagrams* and replacing supports with equivalent supporting forces.
4) Construct a *free body diagram* for parts or the whole of given mechanisms or structures.
5) Differentiate between '*externally applied loads*' and '*internal reactions*'.
6) Apply the *three conditions of equilibrium* to *free body diagrams* and determine the reactions.
7) Describe what is meant by a '*two force member*' and explain the implications for a *free body diagram* involving such members.
8) Apply the principles of equilibrium to the solution of problems involving static systems of pulleys.
9) Describe what is meant by and solve problems involving '*coplanar concurrent force systems*'.
10) Explain the difference between what is known as a '*concentrated load*' and what is known as a '*distributed load*'.
11) Describe what is meant by and solve problems involving '*coplanar parallel force systems*' including both *uniform* and *non-*

uniform beam loading.

12) Describe what is meant by and solve problems involving '*coplanar, non-concurrent force systems*'.

5. ***STRUCTURES AND MEMBERS***

Use the 'method of joints', the 'method of sections' and the 'method of members' to solve for the internal forces in structures such as 'trusses' and 'frames'.

Potential Elements of the Performance:

1) Recognize the difference between the forces of '*tension*' and '*compression*' in structural members such as *struts* and *ties*.
2) Differentiate between the structures known as '*trusses*' and those known as '*frames*'.
3) Identify '*members that carry no load*' in *trusses* and *frames*. Appreciate the importance of identifying such members in the solution of internal forces in structural members such as *trusses* and *frames*.
4) Describe what is meant by a '*two-force member*' and list the implications that this type of member has on the solution of forces in members of *trusses* and *frames*.
5) Describe what is meant by and list the assumptions that apply to, what is known as a '*pin connection*' in a *truss* or a *frame*.
6) Using the method known as the '*Method of Joints*', determine the loads in individual members of *coplanar pin-connected trusses* and *frames* being certain to identify whether the members are in *tension* or *compression*.
7) Using the method known as the '*Method of Sections*' determine the forces in selected members of a *truss* being certain to identify whether the members are in *tension* or *compression*. This will require the drawing of a *free body diagram* of a '*partial truss*' that is part of the entire truss.
8) Describe what is meant by a '*three-force member*' and identify clearly the difference between this type of member and the previously used '*two-force member*'.
9) Using the method known as the '*Method of Members*' determine the forces in members of various mechanisms being certain to identify whether the members are in *tension* or *compression*.

6. ***EQUILIBRIUM OF FORCES IN THREE DIMENSIONS***

Determine forces, moments and reactions, in the context of equilibrium, of three-dimensional rigid bodies.

Potential Elements of the Performance:

1) Explain what is meant by '*isometric sketching*' and use *isometric sketching* to aid in visualizing forces acting on mechanisms in three dimensions.
2) Construct *'isometric free body diagrams'* of the whole, or parts of, three dimensional mechanisms.
3) Apply the six basic equations of *three dimensional equilibrium*, $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma F_z = 0$, $\Sigma M_x = 0$, $\Sigma M_y = 0$, $\Sigma M_z = 0$, to the three-dimensional systems of:
   (a) Parallel forces,
   (b) Concurrent forces, &
   (c) Nonconcurrent forces.

7. ***THE LAWS OF FRICTION***

Apply the laws of friction for dry surfaces to determine if motion is impending or present, and/or whether tipping or sliding will occur.

Potential Elements of the Performance:

1) Write the characteristics that pertain to the force known as the '*friction force*'.
2) Sketch the graph of the *friction force* versus the *applied force* when a force is applied to a block, initially at rest, on a horizontal, flat surface. The *applied force* starts at zero and increases gradually up to the point where the block begins to slide. When sliding at a constant velocity, the applied force tends to decrease, and then remain constant.
3) Indicate clearly the two distinct regions of the graph drawn above, namely, the '*static region*' and the '*kinetic region*'.
4) Explain what is meant by the '*coefficient of friction*'.
5) Write the equation for the '*coefficient of static friction*'.
6) Write the equation for the '*coefficient of kinetic friction*'.
7) Explain what is meant by the '*angle of friction*'.
8) Write the equation for the '*angle of friction*' in terms of the '*maximum force of static friction*' and the '*normal reaction*

force' between the object and the surface upon which it rests.

9) Solve a variety of problems involving friction. These problems will include those that require the student to determine whether *motion is impending or not*. Also, solve those problems that require the student to determine whether *tipping* or *sliding* will occur.

8. ***CENTROIDS AND CENTRES OF GRAVITY IN TWO AND THREE DIMENSIONS***

Apply the concepts of 'centroids' and 'centre of gravity' to the solution of problems in two and three dimensions.

Potential Elements of the Performance:

1) Explain what is meant by the term '*centroid*' of a plane figure or solid object.
2) Explain what is meant by the term '*centre of gravity*' of an object.
3) Describe, using an example, a situation where the *centroid* and the *centre of gravity* of an object coincide. Be certain to list the two conditions that must be met for this to be true.
4) Describe, using an example, a situation where the *centroid* and the *centre of gravity* of an object do not coincide.
5) Locate the *centroids* of simple areas such as squares, rectangles, triangles, circles, semicircles and quarter circles.
6) Calculate the *centroids* of composite areas by breaking the composite area into a number of simple areas and using the *moments* about both the x- and y-axes.

III. TOPICS:

1. ***INTRODUCTION***
   Mathematics of Mechanics
   Conversions of Units

2. ***VECTOR ANALYSIS***
   Vector* and *Scalar Quantities
   ***Forces, Resultants* and *Equilibrants* of force systems**

3. ***MOMENTS AND COUPLES***
   Calculate the twisting effect of forces applied to a rigid body.

4. ***EQUILIBRIUM OF FORCES IN TWO DIMENSIONS***
   Force analysis and summarization with respect to the Three Conditions of Equilibrium

5. ***STRUCTURES AND MEMBERS***
   Force Analysis of Structures using the 'Method of Joints', 'Method of Sections' and the 'Method of Members'.

6. ***EQUILIBRIUM OF FORCES IN THREE DIMENSIONS***
   Force Analysis and summarization with respect to the Six Conditions of Equilibrium

7. ***THE LAWS OF FRICTION***
   Coefficients of Static and *Kinetic Friction*
   Identify and calculate Frictional Forces
   Impending Motion
   Sliding versus Tipping Motion

8. ***CENTROIDS AND CENTRES OF GRAVITY IN TWO AND THREE DIMENSIONS***
   Define and differentiate between a centroid and center of gravity.
   Locate the center of gravity of regular/irregular, homogenous shapes and lines.

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Textbook ISBN: 9780133918922
Author: Hibbeler
Title: Engineering Mechanics – Statics 14th edition

Publisher: Pearson Education

Calculator Scientific
Note: NO graphics calculators or cell/smart phones, allowed during tests or quizzes.

OPTIONAL RESOURCES:

Note: The Study Pack and supporting website are highly recommended for the course.

Website:

MasteringEngineering without Pearson eText -- Instant Access -- for Engineering Mechanics: Statics, 14/E
ISBN: 9780133922288

Study Pack:

Statics Study Pack -- for Engineering Mechanics: Statics, Engineering Mechanics: Statics, 14/E
ISBN: 9780134055800

V. EVALUATION PROCESS/GRADING SYSTEM:

Final grade will be awarded based on the composite score of tests, assignments, and quizzes as follows:

Tests	70%
Quizzes	30%
Total	100%

(The percentages shown above may have to be adjusted to accurately evaluate student skills. Students will be notified of any changes made.)

The professor reserves the right to adjust the mark up or down based on attendance, participation, leadership, creativity, and whether there is an improving trend.

a) Students must complete and pass both the tests and quizzes portions of the course in order to pass the entire course.

b) Quizzes will not necessarily be announced in advance. There are NO make-up or rewrite opportunities with quizzes.

c) Make-up tests are solely at the discretion of the Professor and, depending on the reason for the make-up test, may be assigned a maximum of 60%

d) The Professor reserves the right to adjust the number of tests, quizzes and assignments based on unforeseen circumstances. Students will be provided with sufficient notice to any changes and the reasons thereof.

e) A student who is absent for 3 or more times without prior notification, a valid reason, or no apparent effort to resolve the problem will result in action taken

NOTE: If action is taken, it will range from marks being deducted, to a maximum whereby the student may be removed from the course and assigned an "F" grade

The following semester grades will be assigned to students:

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.

If a faculty member determines that a student is at risk of not being successful in their academic pursuits and has exhausted all strategies available to faculty, student contact information may be confidentially provided to Student Services in an effort to offer even more assistance with options for success. Any student wishing to restrict the sharing of such information should make their wishes known to the coordinator or faculty member.

Applied Mechanics - Statics **MCH110**

VI. SPECIAL NOTES:

Attendance:
Sault College is committed to student success. There is a direct correlation between academic performance and class attendance. Therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

Once the classroom door has been closed, the learning process has begun. Late arrivers will not necessarily be granted admission to the room.

VII. COURSE OUTLINE ADDENDUM:

1. Course Outline Amendments:
   The faculty member reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

2. 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.

3. Prior Learning Assessment:
   Students who wish to apply for advance credit transfer (advanced standing) should obtain an Application for Advance Credit from the program coordinator (or the course coordinator regarding a general education transfer request) or academic assistant. Students will be required to provide an unofficial transcript and course outline related to the course in question. Please refer to the Student Key Dates Calendar for the deadline date by which application must be made for advance standing.

   Credit for prior learning will also be given upon successful completion of a challenge exam or portfolio. Student Services, located in E1101, can provide information regarding the Prior Learning Assessment and Recognition policy or it can be viewed on the student portal.

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

4. Student Portal:
The Sault College portal allows you to view all your student information in one place. **mysaultcollege** gives you personalized access to online resources seven days a week from your home or school computer. Single log-in access allows you to see your personal and financial information, timetable, grades, records of achievement, unofficial transcript, and outstanding obligations, in addition to announcements, news, academic calendar of events, class cancellations, your learning management system (LMS), and much more. Go to https://my.saultcollege.ca.

5. Communication:
The College considers ***Desire2Learn (D2L)*** as the primary channel of communication for each course. Regularly checking this software platform is critical as it will keep you directly connected with faculty and current course information. Success in this course may be directly related to your willingness to take advantage of this Learning Management System (LMS) communication tool.

6. Accessibility Services:
If you are a student with a disability (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with the Accessibility Services office. Visit Room E1101, call Ext. 2703 or email studentsupport@saultcollege.ca so that support services can be arranged for you.

7. Audio and Video Recording Devices in the Classroom:
Students who wish to use electronic devices in the classroom will seek permission of the faculty member before proceeding to record instruction. Students with disabilities who require audio or visual recording devices in the classroom as an accommodation will receive approval from their counsellor once the Audio and Video Recording Devices in the Classroom Policy has been reviewed by the student. Recorded classroom instruction will be used only for individual academic use and will not be used for any other purpose. Recordings may only be used for individual study of materials presented during class and may not be published or distributed. Intentional misuse of audio and video recordings or intentional misrepresentation when requesting the use of a device for recording shall constitute a violation of this policy and laws protecting intellectual property.

8. Academic Dishonesty:
Students should refer to the definition of "academic dishonesty" in the *Student Code of Conduct*. Students who engage in academic dishonesty will be issued a sanction under the Student Code of Conduct which could lead to and include expulsion from the course/program. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, students must use a documentation format for referencing source material.

9. Tuition Default:
Students who have defaulted on the payment of tuition (tuition has not been paid in full, payments were not deferred or payment plan not honoured) as of the first week of November (fall semester courses), first week of March (winter semester courses) or first week of June (summer semester courses) will be removed from placement and clinical activities due to liability issues. This may result in loss of mandatory hours or incomplete course work. Sault College will not be responsible for incomplete hours or outcomes that are not achieved or any other academic requirement not met as of the result of tuition default. Students are encouraged to communicate with Financial Services with regard to the status of their tuition prior to this deadline to ensure that their financial status does not interfere with academic progress.