SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: APPLIED MECHANICS

Code No.: MCH 100-3

Program: MACHINE SHOP

Semester: THREE

Date: JUNE 1989

Author: N. TRIPLETT

New: _____ Revision: X

APPROVED: L. Mozutt Chairperson 84/08/23 Date

CALENDAR DESCRIPTION

APPLIED MECHANICS	MCH 100
Course Name	Course Number

PHILOSOPHY/GOALS:

This course is the first basic course in the Mechanical Programs. A sound knowledge of it is required to progress to advanced levels. It is therefore required that the student apply himself/herself diligently to the work required for successful completion.

METHOD OF ASSESSMENT (GRADING METHOD):

See attached sheet

TEXTBOOK(S):

Introduction to Mechanics - Levinson

APPLIED MECHANICS

MACHINE SHOP

Course Information

1. The course outline and objectives are available for student perusal.

2. Classes will be conducted combining lecture, demonstration and labs.

3. A final grade will be awarded based on the average of tests given during the semester.

4. In the event a student has two or more "I" grades and an average mark below 60% he/she will be required to write a final examination. The results of this final will result in either a "C" grade or an "R".

5. Grades: A - 85% + = Consistently outstanding achievement
   B - 70% + = Consistently above average achievement
   C - 55% + = Average or acceptable achievement

6. Tests will be announced one week in advance.

7. All students are expected to complete assignments on time, be punctual, regular attenders.

APPLIED MECHANICS

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TOPIC NO.	PERIODS	TOPIC
1	6	INTRODUCTION
		Mathematics of Mechanics Conversion of Units
2	12	FORCE SYSTEMS
		Forces Vectors Vector Addition Resultants Moments and Couples
3	6	CENTRE OF GRAVITY
		Determination of Centre of Gravity Centroids
4	9	EQUILIBRIUM
		Equilibrium of two dimensional For Systems Equilibrium of Forces in Space
5	6	MACHINES
		Principle of a Machine Terminology Mechanical Efficiency Velocity Ratio Mechanical Advantage
6	6	FRICTION
		Laws of Friction Angle of Friction Analysis by Equations of Equilibri

APPLIED MECHANICS

MCH 100

Unit # 1 - Mathematics of Mechanics

GENERAL OBJECTIVE:

The student will be able to solve a number of varied problems dealing with the Mathematics of Mechanics.

SPECIFIC OBJECTIVES:

1. To be able to define the term sine of an angle in a right-angled triangle.
2. To be able to define the term cosine of an angle in a right-angled triangle.
3. To be able to define the term tangent of an angle in a right-angled triangle.
4. To be able to state the Sine Law for any triangle.
5. To be able to state the Cosine Law for any triangle.
6. To be able to convert physical quantities of length, time and weight: eg: inches to feet, feet to yards, seconds to minutes, pounds to tons, etc.
7. Using the above specific objectives, the student will solve correctly the following problems in the textbook: Qu. 1-5, 7, 8, 16, 17, 20, 21 22, 24, 27 and 29.

Unit # 2 - Forces

GENERAL OBJECTIVE:

The student will be able to solve a number of varied problems dealing with the characteristics of forces, moments and couples.

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Unit # 2 continued .....

SPECIFIC OBJECTIVES:

1. a) To be able to state Newton's First Law of Force.
   b) To be able to state Newton's Second Law of Force.
   c) To be able to state Newton's Third Law of Force.

2. a) To be able to define the Magnitude of a Force.
   b) To be able to define the Direction of a Force.
   c) To be able to define the Line of Action of a force.

3. To be able to state the meaning of the principle of the transmissibilit of a force.

4. To be able to define the term scalar quantity.

5. To be able to define the term vector quantity.

6. To be able to distinguish between vector and scalar quantities.

7. To be able to add vectors graphically using the String Polygon Method by drawing the vectors accurately to scale and in the proper direction.

8. To be able to define the term Resultant of vector addition.

9. To be able to resolve a force into horizontal and vertical components.

10. a) To be able to add algebraically horizontal components using a rectangular coordinate system.

    b) To be able to add algebraically vertical components using a rectangular coordinate system.

11. To be able to determine the resultant in magnitude of the algebraic vector sum of vertical and horizontal components.

12. To be able to determine the direction of the resultant in of the algebraic vector sum of vertical and horizontal components.

13. To be able to define the term magnitude of the Moment of Force.

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Unit # 2 continued .....

14. To be able to state the theorem of statics: the moment of a force is equal to the sum of the moments of the components of that force.

15. a) To be able to calculate the magnitude of the resultant of a force system by algebraic addition.

    b) To be able to determine the location of the resultant of a force system using the Principle of Moments.

16. To be able to define the term couple.

17. To be able to calculate the magnitude and direction of a couple.

18. To be able to define the term direction cosine in a three dimensional force system.

19. To be able to add direction cosines algebraically.

20. a) To be able to calculate the magnitude of the resultant of a three dimensional force system, using direction cosines.

    b) To be able to calculate the direction of the resultant of a three dimensional force system, using direction cosines.

21. Using graphical means, the student will accurately construct a string polygon to solve for the resultant force in each of the following problems: - 2-10, 11, 12, 34 and 35.

22. Using the calculator the student will solve correctly the following problems by means of algebraic horizontal and vertical vector componen addition: - 2-11, 12, 15, 19, 33, 34, 35, 36 and 37.

23. Using the calculator, algebraic vector component addition and the principle of moments, the student will solve correctly the following problems: - 2-53, 54, 55, 56, 57 and 58.

24. Using the calculator and specific objectives 16 and 17, the student will solve correctly the following problems: 2-62, 63 and 66.

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Unit # 2 continued .....

25. Using the specific objectives 18, 19 and 20, the student will solve correctly the following problems: - 2-43, 44, 45 and 46.

Unit # 3 - Centre of Gravity and Centroids of Section

GENERAL OBJECTIVE:

The student will be able to ascertain both mathematically and experimentall the location of the centre of gravity of mass and the centroid of area.

SPECIFIC OBJECTIVES:

1. To be able to determine the centre of gravity of mass experimentally by suspending the object from various points.

2. To be able to calculate, using the principles of resultants and moments the centre of gravity of grouped particles.

3. To be able to calculate, using the principles of resultants and moments the centroid of any homogeneous plane figure.

4. To be able to recall the formulae for the centroidal location of the centroids of a rectangle, circle, triangle, and semicircle.

5. To be able to calculate the centroidal location of areas using the formulae from specific objective 4.

6. To be able to ascertain from properties of Structural Shape Tables the centroid of Standard Shapes.

7. Using the above objectives, the student will be able to solve correctly the following problems in the textbook: - 3-1, 2, 3, 4, 5, 6, 10, 11, 1
13, 14, 15, 16, 17 and 18.

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Unit # 4 - Equilibrium

GENERAL OBJECTIVE:

The student will be able to calculate the forces, moments or couples required
to maintain equilibrium in any two-dimensional force system.

SPECIFIC OBJECTIVES:

1. To be able to define the term equilibrium.
2. a) To be able to state the equation of Horizontal equilibrium.
   b) To be able to state the equation of Vertical equilibrium.
   c) To be able to state the equation of Moment equilibrium.
3. To be able to define the expression free-body diagram.
4. To be able to draw a free-body diagram.
5. To be able to recall the method of determination of the resultant of a force system.
6. To be able to balance a resultant force to give a condition of equilibrium in a force system.
7. To be able to balance a resultant moment to give a condition of equilibrium in a force system.
8. a) To be able to define the term collinear force system.
   b) To be able to define the term concurrent force system.
   c) To be able to define the term parallel force system.
9. To be able to define the term equilibrant.
10. Using the above specific objectives, the student will solve correctly the following problems: 4-10, 11, 12, 15, 16, 17, 18, 20, 23, 24, 25, 26, 28, 36, 37 and 38.

Unit # 5 - Machines

GENERAL OBJECTIVE:

The student will be able to solve a number of varied problems dealing with typical machines used in industrial applications.

SPECIFIC OBJECTIVES:

1. To be able to state the principle of a machine.

2. To be able to state and sketch the two main parts of a machine.

3. To be able to define the relationship between the effort and the load as it applies to the different types of machines.

4. To be able to state the relationship in the form of Mechanical Advantage
$$= \frac{\text{Load}}{\text{Effort}}.$$

5. To be able to determine the distances moved by the load and the effect.

6. To be able to state the relationship between the distances moved by the load and the effort in the form of
$$\text{Velocity Ratio} = \frac{\text{Distance Moved by Effort}}{\text{Distance Move by Load at Same Time}}$$

7. To be able to define the term Mechanical Efficiency.

8. To be able to calculate mechanical efficiency using the relationships $\frac{MA}{VR} \times 100$, $\frac{\text{Work Out}}{\text{Work In}} \times 100$ and $\frac{\text{Ideal Effort}}{\text{Actual Effort}} \times 100$

9. To be able to calculate the MA, VR and efficiency of the Screw Jack, Level, Wheel and Axle, Inclined Plane, Gear Drives, Belt and Chain Drives and Pulley Systems.

10. Using the calculator and S.O.'s 4, 6 and 8, be able to solve problems typically found in industrial situations where machines are used.

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Unit # 6 - Friction

GENERAL OBJECTIVE:

The student will be able to solve a variety of problems dealing with friction.

SPECIFIC OBJECTIVES:

1. To be able to recall the three equations of equilibrium.

2. To be able to recall the method of free-body diagram construction.

3. To be able to state the three laws of friction.

4. a) To be able to define the term Static Friction.
   b) To be able to define the term Kinetic Friction.

5. a) To be able to apply the static friction force formula.
   b) To be able to apply the kinetic friction force formula.

6. To be able to define the term coefficient of friction.

7. To be able to define the term Normal Force.

8. To be able to define the term Angle of Friction.

9. To be able to explain the relationship between the angle of friction and the coefficient of friction.

10. Using the above objectives, the student will solve correctly, the following problems: 6-4, 5, 6, 7, 8, 9, 10, 11, 13, 15, 16, 17 and 18.