SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: APPLIED MECHANICS

Code No.: MCH 200-3

Program: CIVIL

Semester: TWO

Date: DECEMBER, 1983

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New: Revision:

APPROVED: J.P. Arguitto
Chairperson

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Date

APPLIED MECHANICS MCH 200-3

COURSE MAME COURSE DUMBER

PHILOSOPHY/GOALS:

METHOD OF ASSESSMENT (GRADING METHOD):

1. One weeks notice for tests.

2. Final mark based on average of tests held during the semester.

3. A final examination will be given to all those students who have a final mark below 60% including "two" or more "I" grades. The results of this final exam will be the final mark assigned; a "C" grade or an "R".

4. Grades - A - 75% and up - Consistently outstanding achievement
   B - 65% - 74% - Consistently above average achievement
   C - 55% - 64% - Average or acceptable achievement

5. All students are expected to be punctual, regular attenders and conscientious in their work

APPLIED MECHANICS

MCH 200-3

TOPIC NO.	PERIODS	TOPIC DESCRIPTION
1	6	**MOTION**
		Speed, velocity and acceleration Distance and Displacement Notation Uniformly accelerated bodies Falling bodies Projectiles
		FORCE AND MOTION
		Newton's second law Accelerating forces - horizontal and vertical motion
		WORK, ENERGY AND POWER
		Definitions, units, measurement Concept of work Work done by constant and variable forces Forms of energy - potential and kinetic Conservation of energy
	10	**ROTATIONAL MOTION**
		Angular displacement (radians) Angular velocity and acceleration Relationship between linear and angular motion Moment of inertia of bodies Kinetic energy of rotation Torque Angular momentum

UNIT #1 - MOTION

GENERAL OBJECTIVE

The student will be able to solve a number of varied problems connected with the velocity, acceleration, time and distance that a body required while travelling horizontally and/ or vertically.

SPECIFIC OBJECTIVES

1. **The student will know and be able to define the terms Rectilinear and Curvilinear Motion.**
2. **The student will know and be able to define the terms Scalar and Vector Quantities.**
3. **The student will know and be able to define the difference between Distance and Displacement.**
4. **The student will know and be able to define the difference between Speed and Velocity.**
5. **To be able to explain the term Uniform Motion.**
6. **To be able to state from memory the formula for Uniform Motion V=S**
   1
7. To be able to explain the term Non-uniform Motion.
8. To be able to state from memory the formula for Non-uniform Motion $V_{AVE} = \frac{S}{t}$
9. To be able to sketch the Displacement-Time Diagram.
10. To be able to sketch the Velocity-Time Diagram.
11. To be able to state the meaning of Uniform Acceleration.
12. To be able to state from memory the formula for Uniform Acceleration $A = \frac{Vf - Vo}{tf - to} = \frac{V}{t}$.
13. To be able to state from memory the formula for Uniform Acceleration when to = 0: Vf - Vo = At.
14. To be able to state the formula in which displacement is related to initial velocity, acceleration and time.

$$S = Vot + At2$$

15. To be able to state the formula in which displacement is related to initial velocity, final velocity and acceleration.

$$S = \frac{V^2f - vo^2}{2A}$$

16. To know and be able to state acceleration due to gravity as 32.2 ft/sec^2.

17. To be able to solve problems dealing with objects projected vertically as to the height they will reach; how long it takes to reach this height and the total time in the air.

18. To know and be able to calculate the two types of motion involved in the flight of the projectile - horizontal and vertical.

UNIT #2 - FORCE AND MOTION

GENERAL OBJECTIVE

The student will be able to solve a number of different type problems involving a force action on a body producing an acceleration to the body.

SPECIFIC OBJECTIVES

1. The student will know and be able to state the second law of motion:

a) If an unbalanced force sets on a body it will accelerate in the direction of the unbalanced force.

b) The acceleration will be proportional to the unbalanced force and inversely proportional to the mass of the body.

2. To be able to state the second law in a formula F = ma.

3. To be able to find the mass of a body by dividing the weight by the acceleration due to gravity i.e. Mass = V[slugs.
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4. To be able to apply the two laws of equilibrium EFx and EFy = 0 in solving some types of problems.

5. To be able to draw free body diagrams and show all the forces acting.

6. To be able to adopt a sign convention that is consistent for all the masses in the problem.

7. To be able to write as many equations as there are unknown quantities.

8. To be able to state Newton's Third Law - for every action there is an . equal but opposite reaction.

9. To be able to apply the inertia-force method of analysis.

10. To be able to identify the "reaction" mentioned in the 3rd law as inertia-force, the product of mass and acceleration.

11. To be able to show with the aid of a diagram that a body moving under the action of a force can be said to be in dynamic equilibrium.

12. To be able to solve problems dealing with rotating masses by placing it in dynamic equilibrium and then using the equations of statics: EFx = 0 and EFy = 0.

UNIT #3 - WORK, ENERGY AND POWER

GENERAL OBJECTIVE

The student will be able to solve a number of problems by using the concept of work and energy. Power equivalents will be found by knowing the conversion factors.

SPECIFIC OBJECTIVES

1. To be able to define the term Work.
2. To be able to define the term Energy.
3. To be able to define the term Power.
4. To be able to calculate work done by a force moving through a distance - Work = F x D.
5. To be able to distinguish between positive and negative work.
6. To be able to draw free body diagram of all the forces acting on a body.
7. To be able to determine direction body moves in and assign a positive value to work done by force.
8. To be able to determine resistances to motion and assign a negative value to work done by these resistances.
9. To be able to draw a graph of work done by plotting force against distance.
10. To be able to determine the total work done by finding the area under the curve on the graph.
11. To be able to determine the work done by finding the area under the curve on the graph.
12. To be able to determine the amount of work a spring can do when force is removed.
13. To know and be able to state the force required to stretch or compress a spring is proportional to the change in its length.
14. To know and be able to write the formula which gives the constant of proportionality or the spring constant - K = F/S.
15. To be able to draw a work diagram for a typical spring which has been stretched or compressed.
16. To be able to state the units of energy.

17. To be able to explain the difference between potential energy and kinetic energy.

18. To be able to state that a change in energy is evidence of work done.

19. To be able to state the principle of conservation of energy.

20. To know and be able to state the kinetic energy formula which states K.E. = h W/G V^2.

21. To be able to define the term power.

22. To be able to express power mathematically as $P = \frac{U}{T}$.

23. To be able to express power as the product of force and velocity P = FV.

24. To know and be able to state the conversion factors: 1HP = 550 ft. lb./sec. = 3300 ft. lb/MIN.

1 WATT = .738 ft. lb/sec 1 kw = 738 ft. lb/sec.

UNIT #4 - ROTATIONAL MOTION

GENERAL OBJECTIVE

The student will be able to solve a number of problems dealing with rotating bodies. Also the student will be able to determine the relationship that exists between linear and angular motion.

SPECIFIC OBJECTIVES

1. **To be able to state the definition for motion - when an objects position varies in space with time.**

2. **To recall and be able to state the difference between curvilinear and rectilinear motion.**

3. **To recall and be able to state the difference between:**
   a) Distance - A Scalar Quantity
   b) Displacement - A Vector quantity.

4. To know and be able to state the difference in clockwise rotation and counter-clockwise rotation.

5. To be able to state angular quantities in terms of revolutions, degrees or radians.

6. To be able to convert one quantity of rotation into any of the other two eg. revolutions into radians or degrees.

7. To be able to define the term angular displacement and express it in radians.

8. To be able to define angular distance as a measure of the total angle turned.

9. To be able to state that W(omega) is the symbol used to designate angular velocity = the rate of change of angular displacement.

10. To be able to assign the proper units - radians per second or revolutions per minute to W.

11. To be able to calculate the average angular velocity from the formula - Wave = 9
    t.

12. **To be able to define 8 as a change in angular displacement.**

13. **To be able to define t as an increment of elapsed time.**

14. **To be able to calculate the average acceleration from the formula - AVE = W**
    1.

15. To be able to define W as a change in angular velocity.

16. To be able to define t as an increment of elapsed time.

17. To be able to recall the equations for uniformly accelerated motion and using the symbols for angular motion produce the set of three equations:

$$\theta = \omega_o t + \frac{1}{2}\alpha t^2$$

$$\alpha = \frac{\omega_f - \omega_o}{t}$$

$$\omega_f^2 = \omega_o^2 + 2\alpha\theta$$

18. To know and be able to state the relationship between linear and angular motion:

a) $S = \theta$
b) $V = \omega$
c) $A = \alpha$

19. To know and be able to state the formula for acceleration of a body to ward the centre of rotation (normal acceleration).

$$A_n = \frac{v^2}{r}$$

20. To be able to apply the kinetic energy formula from unit #4 S.O. #20 to a rotational application, where

$V = \omega$ therefore K.E. of Rotation = $\frac{1}{2} \frac{W}{G} (\omega)^2$.

21. To be able to solve problems relating to rotating bodies and their subsequent kinetic energies.