DOC. # **53**

SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ON

COURSE OUTLINE

COURSE TITLE: MECHANICS OF FLUIDS

CODE NO.: **MCH 219-4** **SEMESTER:** TWO **(2)**

PROGRAM: AVIATION TECHNOLOGY (FLIGHT)

AUTHOR: NORMAN TRIPLETT

DATE: OCTOBER 1991 **PREVIOUS OUTLINE DATED:** AUGUST 1988

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DATE

COURSE NAME: MECHANICS OF FLUIDS CODE NO. MCH 219-4

TOTAL CREDIT HOURS

PREREQUISITE(S):

I. PHILOSOPHY/GOALS:

The course is designed to place emphasis on basic principles and their application, in a practical way, as opposed to a theoretical approach. Problems assigned at the end of each new concept assist the student in understanding the subject matter. Transferring the acquired knowledge on to the next concept is a very important step in the learning process.

II. STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student will:

1) **"SEE ATTACHED"**

2)

3)

4)

III. TOPICS TO BE COVERED:

"SEE ATTACHED"

TOPIC NO-	SUGGESTED PERIODS	TOPIC DESCRIPTION

Fundamental Concepts

- temperature
- absolute temperature
- pressure
- definition of terms
- viscosity
- surface tension

Fluid Statics

- pressure relationships
- pressure measurement
- manometers
- forces oh a plane
- forces on a submerged surface
- location of centre of pressure
- buoyancy of submerged bodies
- forces on curved surfaces

Energetics of Steady Flow

- conservation of mass
- force, mass and acceleration
- energy and work
- Bernoulli equation

Fluid Dynamic Applications

- general considerations
- application of Bernoulli
- Torricelli's theorem
- siphons
- pressure and velocity measurements
- piezometer, Pitot tube
- venturi meter

Steady Flow - Incompressible Fluids in Pipes

- laminar & turbulent flow
- laminar flow in tubes
- stoke's law **OPTIONAL**
- boundary layer
- pressure losses in pipe flow

UNIT #1 - Fundamental Concepts

GENERAL OBJECTIVE:

The student will be able to solve a number of different problems dealing with temperature, pressure, viscosity and surface tension.

SPECIFIC OBJECTIVES:

1) The student will be able to define the term "Fluid".

2) The student will be able to define "A Fluid as a Liquid or a Gas".

3) The student will be able to define the term "Temperature".

4) The student will be able to $_{t}$ "Give examples of Physical Indicators of Temperature".

5) The student will be able to "Indicate the difference between the Fahrenheit scale and the Celsius scale".

6) (a) The student will be able to calculate the equivalent temperature in Celsius when given the reading in Fahrenheit using the formula:

$$C° = \frac{5}{y}(F - 32)$$

(b) The student will be able to calculate the equivalent temperature in Fahrenheit when given the temperature in Celsius, using the formula:

$$F° - \frac{(9\ C) + 32}{-5-}$$

7) The student will be able to define the term "Absolute Temperature".

8) The student will be able to "indicate the difference between the Kelvin and Rankin scales".

9) (a) The student will be able to "calculate the equivalent Rankin temperature when given the reading in Fahrenheit".

(b) The student will be able to "calculate the equivalent Kelvin degrees when given the Celsius temperature".

10) The student will be able to define the term "Unit Pressure".

11) The student will be able to define the term "Total Pressure".

12) The student will be able to define the term "Gauge Pressure".

13) The student will be able to define the term "Absolute Pressure".

14) The student will be able to define the term "Density".

15) The student will be able to define the term "Specific Weight".

16) The student will be able to define the term "Specific Volume".

17) The student will be able to define the term "Specific Gravity"

18) The student will be able to define the term "Viscosity".

19) The student will be able to show mathematically, a proof of Viscosity.

20) The student will be able to define the term "Surface Tension".

21) The student will be able to calculate the value of surface tension in lb/ft. for different fluids.

22) The student will be able to define the terms wetting and non-wetting fluids.

23) The student will be able to calculate the rise of a column of fluid in a tube or between two plates.

24) Using a calculator the student will be able to calculate a number of assigned problems pertaining to the forgoing specifi objectives.

UNIT # 2 - FLUID STATICS

GENERAL OBJECTIVE:

The student will be able to solve a variety of problems dealing with pressure measurement and forces acting on bodies immersed in a fluid.

SPECIFIC OBJECTIVES:

1) The student will be able to define the term "Fluid States".
2) The student will be able to show graphically and mathematically, the relationship of pressure and depth of a fluid.
3) The student will be able to calculate the pressure exerted by a fluid on an object at a given depth.
4) The student will be able to state Pascal's Law.
5) The student will recall the definition of Unit Pressure.
6) The student will recall the definition of Gauge and Absolute Pressure.
7) The student will be able to define the term "monometer".
8) The student will be able to define the term "Bourdon Gauge".
9) The student will be able to define the difference between a manometer and a Bourdon Gauge.
10) The student will be able to explain the difference between the "open type and differential type of manometers".
11) The student will be able to draw a "U" tube type of manometer and derive an equation to show how it is able to measure pressure difference.
12) The student will be able to calculate a number of assigned problems dealing with pressure measurement using a manometer,
13) The student will be able to calculate the total force acting on a vertical plate when the top of the plate is level with the surface of the fluid.
14) The student will be able to calculate the total force acting acting on a vertical plate when the top of the plate is some distance below the surface of the fluid.

15) The student will be able to calculate the total force acting on a plate when the top of the plate is level with the free surface of the fluid on one side and below the free surface on the other side.

16) The student will be able to calculate the total force acting on an inclined plate below the free surface of the fluid.

17) The student will be able to define the term "Centre of Pressure".

18) The student will be able to calculate the location of the centre of pressure using the formula:

$$h_p - \frac{I}{h_s} + h$$

19) The student will observe from the calculation of centre of pressure that it always falls below the Centre of Gravity of a plane area.

20) The student will be able to calculate the resultant force acting on a flat plate in any position, and also the Centre of Pressure for that plate when assigned a number of problems

21) The student will be able to recognize the difference between forces acting on flat surfaces and forces acting on curved surfaces.

22) The student will be able to calculate the total force acting on a curved surface when assigned a number of problems.

23) The student will be able to define the term "Stress".

24) The student will be able to define the term "Thin Walled Cylinder".

25) The student will be able to write from memory, the formula for longitudinal stress in a thin walled cylinder:

Pd

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26) The student will be able to write from memory, the formula for circumferential stress in a thin walled cylinder:

Pd

27) The student will be able to write from memory, the formula for the stress induced in a sphere:

Pd

) The student will be able to write from memory "Archimede's Law".

) The student will recall the definition for Specific Gravity.

) The student will be able to define the term "Force of Buoyancy".

) The student will be able to solve a number of assigned problems dealing with displacement of a fluid and buoyant force.

UNIT #3 - ENERGETICS OF STEADY FLOW

GENERAL OBJECTIVE:

The student will be able to solve a variety of assigned problems dealing with force, mass and acceleration, also problems concerned with work and energy.

SPECIFIC OBJECTIVES:

1) The student will recall a fluid at rest deals with the problem of Statics and equilibrium.
2) The student will be able to define the term "Laminar Flow".
3) The student will be able to define the term "Turbulent Flow".
4) The student will be able to' define the term "Conservation of Mass".
5) The student will be able to write from memory, the formula:

$$Q - A_1V_1 - A_2V_2 \ ...$$

6) The student will be able to define the term "mass".
7) The student will be able to define the term "force".
8) The student will be able to define the term "acceleration".
9) The student will be able to write from memory, the formula:

$$F - ma$$

10) The student will be able to calculate a number of assigned problems dealing with F = ma.
11) The student will be able to define the term "work".
12) The student will be able to define the term "energy".
13) The student will be able to explain the difference between Kinetic and Potential Energy,
14) The student will be able to define the term "Conservation of Energy".
15) The student will be able to write from memory, the formula for Kinetic Energy:

$$\frac{Wv^2}{7g}$$

16) The student will be able to write from memory the formula for Work:

Work - F x S

17) The student will be able to show the relationship that exists between Kinetic Energy, Potential Energy and Work.

18) The student will be able to calculate a number of assigned problems made up of work and energy.

19) The student will be introduced to the Bernoulli equation.

20) The student will recall the Work and Energy formulas and identify these in the Bernoulli equation.

21) The student will be able to write from memory, the Bernoulli equation.

UNIT #4 - FLUID DYNAMICS - APPLICATIONS

GENERAL OBJECTIVE:

The student will be able to solve a number of assigned problems dealing with such items as application of Bernoulli's equation, Torricelli's Theorem, siphons, pressure and velocity measurements.

SPECIFIC OBJECTIVES:

1) The student will recall the formula for Potential Energy and Kinetic Energy.
2) The student will recall the formula for pressure at a depth.
3) The student will recall the formula for the Bernoulli equation.
4) Using the Bernoulli equation the student will be able to solve for any of the terms that are unknown when solving a particular problem.
5) The student will be able to solve siphon problems using the Bernoulli equation.
6) The student will be able to use the Bernoulli equation to solve for pressure and velocity at any point in a fluid flow.
7) The student will be able to rearrange the Bernoulli equation to show that an increase in Kinetic Energy is equal to a decrease in Potential Energy.
8) The student will be able to define this change of energy as the Venturi Principle.
9) The student will be able to sketch a Venturi meter.
10) The student will recall the "U" tube type monometer.
11) The student will be able to define the term "Differential Monometer".
12) The student will be able to sketch a Venturi meter with a differential monometer connected to it.
13) The student will be able to solve problems dealing with the flow of fluids through pipes using the Venturi meter and an application of the Bernoulli equation.

14) The student will be able to define the term "Pitot tube".
15) The student will be able to define the term "Piezometer".
16) The student will be able to calculate problems of fluid flow using Pitot tubes and Piezometer as measuring devices

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V. EVALUATION METHODS: (INCLUDES ASSIGNMENTS, ATTENDANCE REQUIREMENTS, ETC.)

The course outline and objectives are available for student perusal.

Classes will be conducted combining lecture, demonstration and labs.

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

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 a "C" grade or an "R".

Grades: A+ - 90+ - Consistently outstanding
A - 80+ - Outstanding achievement
B - 70+ - Consistently above average achievement
C - 60+ - Average or acceptable achievement

Tests will be announced one week in advance.

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

VI. REQUIRED STUDENT RESOURCES

TEXTBOOK:

REFERENCE: Hydraulics - King, Wisler, Woodburn
Fluid Mecnanics for Eng. Technology - Granet
Fluid power for Technicians - Newton

REFRENCES: Hydraulics - King, Wisler, Woodburn
worfted Examples in Applied Mechanics - Jones, Day & Williams
Fluid Power for Technicians - Newton

VII. ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY:

VIII. SPECIAL NOTES

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

Your instructor reserves the right to modify the course as he/she deems necessary to meet the needs of students.