SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: MECHANICS OF FLOlDS

Code No.: MCH 219-4

Program: AVIATION

Semester: TWO

Date: AUGUST 1988

Author: NORMAN TRIPLETT

New: Revision: X

APPROVED: _____

Chairperson Date

MECHANICS OF FLUIDS — Course Name

MCH 219-4 — Course Number

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.

METHOD OF ASSESSMENT:

- See Attached Sheet -

TEXTBOOK:

Reference: Hydraulics - King, Wisler, Woodburn

Fluid Mechanics for Eng. Technology - Granet

Fluid Power for Technicians - Newton

REFERENCES:

Hydraulics——King, Wisler, Woodburn

Worked Examples In Applied Mechanics——Jones, Day & Williams

Fluid Power for Technicians——Newton

APPLIED MECHANICS

AVIATION TECHNICIAN CLASS

Course Information

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 a "C" grade or an "R".

Grades: A - *&Q* + - Consistently outstanding achievement

B - *lO* + - Consistently above average achievement

C - *^Q* + - 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.

Instructor:

Mr. N. Triplett

FLUID MECHANICS

MCH 219-4

TOPIC NO. PERIODS TOPIC INFORMATION

Fundamental Concepts

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

Fluid Statics

- pressure relationships
- pressure measurement
- manometers
- forces on 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
- torn"eelli's theorem
- siphons
- pressure and velocity measurements
- piezometer, pi tot tube
- venturi meter

Steady Flow—Incompressible Fluids In Pipes

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

MECHANICS OF FLUIDS

Unit #1 - Fundamental Concepts

General Objective:

The student will be able to solve a number of different problems dealing with temperature$_4$ 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 "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 i Celsius when given the reading in Fahrenheit using the formula:

$$C° = \frac{5}{9}(F - 32)$$

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

$$F° = \frac{(9\ C)}{5} + 32$$

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".

9. (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 16 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 or slide rule the student will be able to calculate a number of assigned problems pertaining to the forgoing specific 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 "manometer".
8. The student will be able to define the term "Bourdon Gauge".
9. The student will be able to define the difference between a monometer and a Bourdon Gauge.
10. The student will be able to explain the difference between the "open type and differential type of monometers".
11. The student will be able to draw a "U" tube type of monometer 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 monometer.

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 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:

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:

$$\frac{Pd}{}$$

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

$$\frac{Pd}{It}$$

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

$$\frac{Pd}{Tt}$$

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

29. The student will recall the definition for Specific Gravity.

30. The student will be able to define the term "Force of Bouyancy".

31. The student will be able to solve a number of assigned problems dealing with displacement of a fluid and bouyant 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:

$$Q = AJVJ = A_2V_2 \quad .-.$$

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:

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

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

$$Work = F \times S$$

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 Obective:

The student will be able to solve a number of assigned problems dealing with such items as application of Bernoull'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.

The student will be able to define this change of energy as the Venturi Principle.

The student will be able to sketch a Venturi meter.

The student will recall the "U" tube type of monometer.

The student will be able to define the term "Differential Monometer".

The student will be able to sketch a Venturi meter with a differential monometer connected to it*

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.

The student will be able to define the term "Pitot tube".

The student will be able to define the term "Piezometer".

The student will be able to calculate problems of fluid flow using Pitot tubes and Piezometer as measuring devices.