



**I. COURSE DESCRIPTION:**

This course is an introduction to fluids their properties and coherent units of measurement, pressure, vapour pressure, vacuum, Pascal's Law with an emphasis on pressure measuring devices; buoyancy, Bernoulli's equation, flow of fluids, velocity and flow measuring instruments.

**II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:**

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

**1. *Introduction To Fluid Mechanics/Fluid Properties*****Potential Elements of the Performance:**

- Demonstrate an understanding of unit conversions related to fluids, extensive and intensive properties, homogeneous and non-homogeneous fluids and fluid characteristics such as:
  - a. Unit Conversions related to fluids
  - b. Extensive and intensive properties of fluids
  - c. Homogeneous and non-homogeneous fluids
  - d. Properties and characteristics of fluids such as mass / weight, flow of heat, viscosity, surface tension, vapour pressure and elasticity

**2. *Fluid Statics*****Potential Elements of the Performance:**

- Define and calculate pressure; absolute, gauge and vacuum.
- Analyze pressure variation with elevation
- Utilize the basic differential equation (equation of equilibrium) to solve complex problems
- Demonstrate an understanding of uniform density
- Demonstrate an understanding of the characteristics of compressible fluids and solve related problems
- Utilize manometers and other pressure measuring devices (Bourdon/Strain/Quartz gauges) and have a full understanding of how these devices work
- Illustrate understanding of hydrostatic forces on both plane and curved surfaces
- Demonstrate an understanding of Buoyancy and Stability of Immersed and Floating Bodies

### 3. ***Fluids in Motion***

#### Potential Elements of the Performance:

- Define and understand velocity and flow including concepts such as Lagrangian and Eulerian viewpoints, streamlines and flow patterns, laminar and turbulent flow
- Utilize alternate methods to develop flow patterns: Analytical, Numerical and Experimental
- Define and illustrate understanding of volume rate of flow, as well as mean and average velocity
- Explain the concept of acceleration including normal and tangential components, Cartesian components, convective and local acceleration
- Define system, control volume and control surface in reference to the basic control volume approach
- Identify and differentiate between extensive and intensive properties
- Derive the control volume equations and illustrate understanding of the control volume equation for steady state flow
- Explain and utilize the general form of the continuity equation and the continuity equation for steady one dimensional flow in a conduit
- Explain the concept of rotation and vortices

### 4. ***Pressure Variation in Flowing Fluids***

#### Potential Elements of the Performance:

- Explain the basic causes of pressure variation in a flowing fluid using examples that include pressure variation due to weight and acceleration
- Illustrate understanding and application of the Bernoulli Equation along a streamline and for irrotational flow
- Demonstrate problem solving skills utilizing the Bernoulli equation for complex problems

### 5. ***Momentum Principle***

#### Potential Elements of the Performance:

- Derive and Utilize the momentum equation
- Illustrate the ability to interpret the momentum equation including the force terms, momentum accumulation, momentum flow, momentum diagrams
- Utilize the momentum equation for Cartesian coordinates
- Explain and demonstrate knowledge of the systematic approach
- Explain typical applications such as fluid jets, nozzles, vanes and pipes

- Utilize and understand the moment of momentum equation and the Navier-Stokes equation

### III. TOPICS:

1. Introduction to Fluid Mechanics and Fluid Properties
2. Fluid Statics
3. Fluids in Motion
4. Pressure Variation in Flowing Fluids
5. The Momentum Principle

### IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

*Crowe, Clayton T., Engineering Fluid Mechanics, 7<sup>th</sup> Ed., John Wiley and Sons, Inc, ISBN 0-471-38482-8*

### V. EVALUATION PROCESS/GRADING SYSTEM:

Type of Grading	Duration	Mark Breakdown	Topics
Term Test 1	2.0 hours	20%	Introduction to Fluid Mechanics and Fluid Statics
Term Test 2	2.0 hours	20%	Fluids in Motion/Pressure Variation in Flowing Fluids
Final Exam	2.0 hours	30%	All course Material
Quiz	0.5 hours x4	10%	All course Material
Homework, Laboratory Work, Attendance	8.0 hours	20%	All Experiment assignments and attendance

The following semester grades will be assigned to students:

<b>Grade</b>	<b><u>Definition</u></b>	<i>Grade Point Equivalent</i>
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.	

## **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.

## **VII. COURSE OUTLINE ADDENDUM:**

The provisions contained in the addendum located on the portal form part of this course outline.

## APPENDIX



**ENVIRONMENTAL TECHNICIAN –  
WATER (5062)  
*Hydraulics – WTR330***

## DISTRIBUTION OF HOURS

<b>Sequence/Type</b>	<b>Topics</b>	<b># of Hours</b>
<b>Lecture</b>	Introduction/Fluid Properties	4
<b>Experiment</b>	Experiment 1A/1B	4
<b>Lecture</b>	Fluid Statics	10
<b>Lab</b>	Lab #1 (Presentation of Measuring Devices)	2
<b>Experiment</b>	Experiment 2A	2
<b>Experiment</b>	Experiment 2B	2
<b>Lab</b>	Lab #2 - Review Solving Problems from Chapter 1 and 2	2
<b>Test</b>	Term 1 Test	2
<b>Lecture</b>	Fluids in Motion	8
<b>Experiment</b>	Lab #3	2
<b>Experiment</b>	Lab #4	2
<b>Lab</b>	Review – In Class Lab Solving Problems from Chapter 3	2
<b>Test</b>	Term 2 Test	2
<b>Lecture</b>	Momentum Principle	8
<b>Lab</b>	Lab 5A/5B	4
<b>Lab</b>	Lab 6A/6B	4
<b>Lab</b>	Final Review of all course material	2
<b>Testing</b>	Final Exam	2
	<b>Sub-Totals</b>	
	Lectures	30
	Labs/Experiments	28
	Testing	6
	<b>TOTAL HOURS</b>	<b>64</b>



## ENVIRONMENTAL TECHNICIAN – WATER (5062) *Hydraulics – WTR330*

**COURSE PLAN** – Based on the text *Engineering Fluid Mechanics*, 7<sup>th</sup> ed., by Crowe, Roberson and Elger)

<b>Week/Hours</b>	<b>Topic/Chapter</b>	<b>Concepts Covered</b>	<b>In Class Lab (equipment needed)</b>
<b>Week 1/2</b> (4 hours Lecture and 4 hours Lab)	<b>Introduction to the Course;</b> <b>Chapter 1/2 :</b> Dimensions and Units, Methods of Description	<ol style="list-style-type: none"> <li>1. Characteristics of a fluid/Fluid as a continuum.</li> <li>2. Units and conversions (SI/BG Units)</li> <li>3. Extensive and Intensive properties</li> <li>4. Homogeneous and non-homogeneous/Consistent and Inconsistent Formulas</li> <li>5. Properties of fluids involving the mass or weight</li> <li>6. Properties of fluids involving the flow of heat</li> <li>7. Viscosity</li> <li>8. Newtonian vs. non-Newtonian Fluids</li> <li>9. Surface tension, vapour pressure, Elasticity,</li> </ol>	Experiment 1A and 1B (4 hours) Fluid
<b>Week 3</b> (4 Hours Lecture)	<b>Chapter 3: Fluid Statics:</b> Basic Equation, Pressure Variation in a Static Fluid	<ol style="list-style-type: none"> <li>1. Pressure: definition, transmission and difference between absolute/gauge/vacuum</li> <li>2. Pressure Variation with Elevation: Basic Differential Equation (equation of equilibrium), uniform density, Compressible Fluids</li> </ol>	
<b>Week 4</b> (2 Hour Lecture and 2 hour lab)	<b>Fluid Statics:</b> Pressure Measurement	<ol style="list-style-type: none"> <li>1. Manometry</li> <li>2. Pressure Measurement</li> </ol>	Lab #1 – suggest 2 hours Presentation on metering devices with examples of metering devices in lab

<b>Week 5</b> (2 Hour Lecture and 2 hour lab)	<b>Fluid Statics:</b> Forces on Submerged Surfaces	1. Hydrostatic Forces on plane surfaces 2. Hydrostatic forces on curved surfaces	Experiment 2A – 2 hours
<b>Week 6</b> (2 Hours Lecture and 2 hours lab)	<b>Fluid Statics:</b> Buoyancy/Stability	1. Buoyancy 2. Stability of Immersed and Floating Bodies	Experiment 2B – 2 hours
<b>Week 7</b> (4 Hours)	Review and Term Test 1		Lab #2 - Home Work Review Lab
<b>Week 8</b> (2 Hours Lecture )	<b>Chapter 4: Fluids in Motion</b>	1. <b>Velocity and flow visualization:</b> Lagrangian and Eulerian Viewpoints, Streamlines and flow patterns, Laminar and Turbulent Flow, Methods to develop flow patterns (Analytical/Numerical/Experimental) 2. <b>Rate of Flow:</b> volume rate of flow, mean or average velocity 3. <b>Acceleration:</b> Normal and Tangential components, Cartesian components, convective and local acceleration	Experiment 3 - (2 Hours)
<b>Week 9</b> (4 Hours Lecture)	<b>Chapter 4: Fluids in Motion</b>	1. <b>Basic Control – Volume Approach:</b> System, control volume and control surface, Review of extensive and Intensive properties, Derivation of Control Volume Equations, Control Volume Equation for Steady Flow	
<b>Week 10</b> (2 Hours Lecture and 2 hour Experiment)		1. <b>Continuity Equation:</b> General Form of the continuity equation, continuity equation for steady one-dimensional flow in a conduit, continuity at a point 2. <b>Rotation and Vorticity:</b> Concept of rotation, Vortices,	Experiment 4 (2 Hours)
<b>Week 11</b> (4 Hours)	Review and Term Test 2		Lab #3 – Home Work Review

<b>Week 12/13</b> (4 Hours Lecture and 4 hours lab)	<b>Chapter 5:  Pressure  Variation in  Flowing Fluids</b>	1. <b>Basic Causes of Pressure Variation in a Flowing Fluid:</b> pressure variation due to weight and acceleration, examples of pressure variation resulting from acceleration, rotation of a tank liquid 2. <b>Bernoulli Equation:</b> along a streamline, for irrotational flow 3. <b>Application of the Bernoulli Equation:</b>	Experiment 5A and 5B (4 hours)
<b>Week 14/15</b> (4 Hours Lecture and 4 hours lab)	<b>Chapter 6:  Momentum  Principle</b>	1. <b>Momentum Equation:</b> Derivation 2. <b>Interpretation of the Momentum Equation:</b> force terms, momentum accumulation, momentum flow, momentum diagram, momentum equation for Cartesian Coordinates, systematic approach 3. <b>Typical Applications:</b> Fluid Jets, Nozzles, Vanes, Pipes, 4. <b>Moment of Momentum Equation</b> 5. <b>Navier-Stokes Equation</b>	Experiment 6A and 6B (4 hours)
<b>Week 16</b> (4 Hours)	Final Review and Exam		Lab #4 - Home Work Review Lab