SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE:	FLUID MECHANICS II		
CODE NO. :	MCH225	**SEMESTER:**	SIX
PROGRAM:	MECHANICAL ENGINEERING TECHNOLOGY		
AUTHOR:	MARK S. SEELER		
DATE:	JAN 2014	**PREVIOUS OUTLINE DATED:**	JAN 2012
APPROVED:	*"Corey Meunier"* **CHAIR**		**DATE**
TOTAL CREDITS:	FIVE		
PREREQUISITE(S):	MCH125 - MECHANICS OF FLUIDS MCH320 – MACHINE DYNAMICS		
HOURS/WEEK:	THREE		

I. COURSE DESCRIPTION:

A course is an extension of MCH125 and will cover topics pertaining to energy as it relates to fluid, dimensional analysis, the use of boundary layers, flow in conduits including turbulent and laminar flow, pressure/velocity and flow measurements.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

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

1. Review of Fluid Mechanics I and The Energy Principle

Potential Elements of the Performance:

- Demonstrate knowledge of how the control volume approach is applied to the first law of thermodynamics
- Understand and explain the concepts of flow work and shaft work
- Write, understand and apply the basic and more general form of the energy equation
- Apply forms of the energy equation for situations such as steady flow of an incompressible fluid in a pipe, non-viscous flow and incompressible flow
- Applications of the Energy, Momentum and Continuity Equation in combination and understanding of the concept of abrupt expansion and forces on transition
- Understand and Explain the concept of hydraulic and energy grade lines
- Reynolds number and Darcy Weisbach equation for losses in a hydraulic system
- Laminar and Turbulent Flow

2. Velocity Profiles in Circular Sections and Flow in Non-Circular Sections

Potential Elements of the Performance:

- Describe the velocity profile for laminar and turbulent flow in circular cross sections
- Describe the laminar boundary layer as it occurs in turbulent flow.
- Compute the local velocity of flow at any given radial position in a circular cross section
- Compute average flow velocity in noncircular cross sections
- Compute the Reynolds number for flow in noncircular cross sections using the hydraulic radius to characterize the size of the cross section.

- Determine the energy loss for the flow of a fluid in a noncircular cross section, considering special forms for the relative roughness and Darcy's equation.

3. Minor Losses

Potential Elements of the Performance:

- Recognize the sources of minor losses.
- Define the resistance coefficient
- Determine the energy loss for flow through the following types of minor losses:
  - A) Sudden enlargement of the flow path.
  - B) Exit loss when fluid leaves a pipe and enters a static reservoir.
  - C) Gradual enlargement of the flow path.
  - D) Sudden contraction of the flow path.
  - E) Gradual contraction of the flow path.
  - F) Entrance loss when fluid enters a pipe from a static reservoir.
- Be able to define the term 'vena contracta'
- Be able to define and use the equivalent length technique for determining energy losses in system components
- Be able to demonstrate how to use the flow coefficient Cv to evaluate energy losses in some types of valving.

4. Series Pipeline Systems

Potential Elements of the Performance:

- Understand and be able to identify a series pipeline system
- Be able to determine the class of the pipeline system
- Determine the sources of energy losses in a system and determine what the losses are.
- Have the ability to design systems based on incomplete information and size components accordingly, based on Class II and Class III requirements.

5. Parallel Pipeline Systems

Potential Elements of the Performance:

- Understand the difference between Parallel and Series Pipeline systems
- Be able to state the general relationships for flow rates and head losses for parallel pipeline systems.
- Compute flow in each branch of a parallel pipeline system
- Understand and use the Hardy Cross technique to compute the flow rates in all branches of a network having three or more branches.

6. Pump Selection and Application

Potential Elements of the Performance:

- Be able to list the information and parameters required for pump selection
- Describe and understand the applications and limitations for each of the basic pump classifications
- Understand the differences between positive and variable displacement pumps
- Be able to read pump curves and understand the relationship to pump performance for each style of pump
- Describe how the operating point of a pump is related to system resistance information
- Define the net positive suction head for a pump and discuss its significance to pump performance.
- Be able to identify and define optimal system designs for pump installations.B

7. Open Channel Flow

Potential Elements of the Performance:

- Compute the hydraulic radius for open channels
- Describe uniform and varied flow
- Use Manning's equation to analyze uniform flow.
- Be able to compute flow and depth parameters for and open channel
- Define the Froude number
- Describe critical flow, sub-critical flow, and supercritical flow
- Be able to determine the energy in the flow of an open channel
- Understand what is meant by the term hydraulic jump.
- Describe weirs and flumes and how they are used for measuring flow in open channels

III. TOPICS:

1. Review of Fluid Mechanics I and The Energy Principle
2. Velocity Profiles in Circular Sections and Flow in Non-Circular Sections
3. Minor Losses
4. Series Pipeline Systems
5. Parallel Pipeline Systems
6. Pump Selection and Application
7. Open Channel Flow

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Robert L. Mott., Applied Fluid Mechanics, 6th Ed., Pearson Prentice Hall Tm, ISBN 0-13-114680-7

V. EVALUATION PROCESS/GRADING SYSTEM:

Type of Grading	Duration	Mark Breakdown	Topics
Mid-Term Test	**3.0 hours**	**30%**	**Energy Principle/ Dimensional Analysis and Similitude**
Quizes, Homework and Attendance		**20%**	**Surface Resistance/ Flow In Conduits**
Final Exam	**3.0 hours**	**50%**	**All course Material**

The following semester grades will be assigned to students:

Grade	Definition	*Grade Point Equivalent*
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

MECHANICAL ENGINEERING TECHNOLOGY - 4043
Mechanics of Fluids II – MCH225

DISTRIBUTION OF HOURS

Sequence/Type	Topics	# of Hours
Lecture	Review of Fluid Mechanics I Reynolds Number, Laminar and Turbulent Flow and Energy Losses	6
Lecture	Velocity Profiles for Circular Sections and Flow in Non-Circular Section	6
Lecture	Minor Losses From System Components	6
Mid-term Exam		3
Lecture	Series Pipeline Systems	6
Lecture	Parallel Pipeline Systems	6
Lecture	Pump Selection and Application	6
Lecture	Open-Channel Flow	6
Testing	Final Exam	3
	Sub-Totals	
	Lectures	42
	Testing	3
	Exam	**3**
	Total	**48**

SAULT COLLEGE

MECHANICAL ENGINEERING TECHNOLOGY - 4043

Mechanics of Fluids II – MCH225

COURSE PLAN – Based on the text **Applied Fluid Mechanics**, 6th ed., by Robert L. Mott

Week/Hours	Topic/Chapter	Concepts Covered
Week 1/2 6 hours Lecture	**Review of Fluid Mechanics I concepts and The Energy Principle**	**1. Review of Areas Covered in Fluid Mechanics I**
Week 3/4 6 hours Lecture	**Chapter 9: Velocity Profiles for Circular Sections and Flow in Non-Circular Section**	1. **Velocity Profiles** 2. **Velocity Profiles for Laminar Flow** 3. **Velocity Profiles for Turbulent** 4. **Computational Flow Dynamics**
Week 5/6 6 hours Lecture	**Chapter 10: Minor Losses**	1. **Resistance Coefficient** 2. **Sudden Enlargement** 3. **Exit Loss** 4. **Gradual Enlargement** 5. **Sudden Contraction** 6. **Gradual Contraction** 7. **Entrance Loss** 8. **Resistance Coefficient**
Week 7 3 hours Lecture	**Chapter 11: Series Pipeline Systems**	**1. Class I systems** **2. Class II systems** **3. Class III systems**
Week 8/9 3 hours	**Mid-Term Exam and Reading Week**	
Week 10/11 6 hours Lecture	**Chapter 12: Parallel Pipeline Systems**	1. **Systems with Two Branches** 2. **Systems with Three or More Branches (Networks)**
Week 12/13 6 hours Lecture	**Chapter 13: Pump Selection and Application**	1. **Parameters involves with Pump Selection** 2. **Types of Pumps** 3. **Positive Displacement Pumps** 4. **Kinetic Pumps** 5. **Centrifugal Pumps** 6. **Operating Point of Pumps and System Design** 7. **Net Positive Suction Head** 8. **Suction Line Details** 9. **Discharge Line Details** 10. **Piping System Design and Pump Selecton**

		11. **Life Cycle Costs for Pumped Fluid Systems**
Week 14/15 6 hours Lecture	**Chapter 14: Open Channel Flow**	1. **Classifications of Open-Channel Flow** 2. **Hydraulic Radius and Reynolds Number in Open-Channel Flow** 3. **Kinds of Open-Channel Flow** 4. **The Geometry of Typical Open Channels** 5. **Critical Flow and Specific Energy** 6. **Hydraulic Jump** 7. **Open-Channel Flow Measurement**
Week 16 3 hours	**FinalExam**	