MESABI RANGE COMMUNITY & TECHNICAL COLLEGE – VIRGINIA/EVELETH

Course Outline

Course Title:	**Fluid Mechanics**	**Submitted By:**	**M. Threapleton**
Semester Course Prefix and Number:	**ENGR 2440**	**Approval Date:**	**April 2002**
Old Quarter Course Prefix and Number:		**Revision Date:**	**April 2002**

Number of Credits:
Semester(s) Offered:
Negotiated Class Size:
Number of Lecture Credits:
Number of Lab Credits:
Number of Lab Hours:
Number of Studio/Demonstration/Internship Credits:

Course Purpose Code:

_____ **0 –** Developmental Courses
_____ **1 –** Non-transferable, General Education
_____ **2 –** Technical course related to career programs
_____ **3 –** College course which has the primary goal of applying certain concepts (e.g. vocal ensemble)
__X__ **4 -** Other college course not considered a part of general education (MNTC) e.g. computer science, health, physical education
_____ **5 –** Course which is intended to fulfill the Minnesota Transfer Curriculum (MNTC) requirements.
_____ **9 –** Continuing Education/Customized Training specialized credit course (not occurring in 0-5)

Catalog Description:
This course covers fluid properties, fluid dynamics, transport theory and analogies, conservation of mass, energy, and momentum, dimensional analysis, boundary layer concepts, pipe flows, and compressible and open-channel flow. This course is intended for engineering majors and includes open-ended design.

Prerequisites and/or recommended entry skills/knowledge:

Course Prerequisite(s):	ENGR 2410 – Statics
Reading Prerequisite:	None
Composition Prerequisite:	None
Mathematics Prerequisite:	None

Career Programs and Transfer Majors Accessing this Course:
Engineering transfer students in aerospace, chemical, civil, and mechanical engineering.

Minnesota Transfer Curriculum Goal(s) partially met by this course if applicable: Notes: No more than two goals may be met by any one course. (Curriculum Committee review and the Chief Academic Officer's approval are required).

0. __X__ None
1. _____ Communications
6. _____ The Humanities and Fine Arts
7. _____ Human Diversity

2. _____ Critical Thinking
3. _____ Natural Sciences
4. _____ Mathematical/Logical Reasoning
5. _____ History and the Social and Behavioral Sciences
8. _____ Global Perspectives
9. _____ Ethical and Civic Responsibility
10. _____ People and the Environment

Learning outcomes, including any relevant competencies listed in the Minnesota Transfer Curriculum:
The student will:

1. identify, define, and apply fluid properties including symbols, units, and physical sense.
2. develop and apply equations for fluid statics.
3. derive the continuity equation.
4. apply Bernoulli's Equation to several open and closed systems.
5. apply the momentum equation.
6. derive the energy equation.
7. perform dimensional analysis.
8. apply Reynolds Number to laminar and turbulent flow.
9. perform extensive conduit flow analysis.
10. analyze compressible flow.
11. explain principle workings of flow measurement devices.
12. complete an extensive capstone design project in a team environment and submit a professional report.

Student assessment methods:
The final grade is determined by grades earned on homework problems, periodic examinations, a comprehensive design project, and a comprehensive final examination.

Use of instructional technology (includes software, interactive video and other instructional technologies):
The students will use Microsoft Office computer software, Graphical Analysis computer software, and computer projection equipment.

Outline of the major course content:
Fluid properties

A. Basic units
B. System: extensive and intensive properties
C. Properties involving the mass or weight of the fluid
D. Properties involving the flow of heat
E. Viscosity
F. Elasticity
G. Surface tension
H. Vapor pressure

II. Fluid statics

A. Pressure
B. Pressure variation with elevation
C. Pressure measurements
D. Hydrostatic forces on plane surfaces
E. Hydrostatic forces on curved surfaces
F. Buoyancy
G. Stability of immersed and floating bodies

III. Fluids in motion

A. Velocity and flow visualization
B. Rate of flow

C. Acceleration
D. Basic control-volume approach
E. Continuity equation
F. Rotation and vorticity
G. Separation

IV. Pressure variation in flowing fluids
A. Basic causes of pressure variation in a flowing fluid
B. Examples of pressure variation resulting from acceleration
C. Bernoulli's Equation
D. Application of Bernoulli's Equation
E. Separation and its effect on pressure variation
F. Cavitation
G. Navier-Stokes Equations

V. Momentum principle
A. The momentum equation
B. Applications of the momentum equation
C. Moment-of-momentum equation

VI. Energy principle
A. Derivation of the energy equation
B. Simplified forms of the energy equation
C. Application of the energy, momentum, and continuity equations in combination
D. Concept of the hydraulic and energy grade lines

VII. Dimensional analysis and similitude
A. The need for dimensional analysis
B. Dimensions and equations
C. The Buckingham Pi theorem
D. Dimensional analysis
E. Common dimensional analysis
F. Similitude
G. Model studies for flows without free-surface effects
H. Significance of the pressure coefficient
I. Approximate similitude at high Reynolds Numbers
J. Free-surface model studies

VIII. Surface resistance
A. Surface resistance with uniform laminar flow
B. Qualitative description of the boundary layer
C. Quantitative relations for the laminar boundary layer
D. Quantitative relations for the turbulent boundary layer

IX. Flow in conduits
A. Shear-stress distribution across a pipe section
B. Criterion for laminar or turbulent flow in a pipe
C. Turbulent flow in pipes
D. Flow at pipe inlets and losses from fittings
E. Pipe systems
F. Turbulent flow in noncircular conduits

X. Drag and lift
A. Basic considerations
B. Drag of two-dimensional bodies
C. Vortex shedding from cylindrical bodies
D. Effect of streamlining
E. Drag of axisymmetric and three-dimensional bodies
F. Terminal velocity
G. Effect of compressibility on drag
H. Lift

XI. Compressible flow

A. Isentropic compressible flow through a duct with varying area
B. Compressible flow in a pipe with friction

XII. Flow measurements
A. Instruments for the measurement of velocity and pressure
B. Instruments and procedures for measurement of flow rate
C. Measurement in compressible flow

Additional special information (special fees, directives on hazardous materials, etc.)
A scientific calculator with exponential and logarithmic capabilities is required for this course. Engineer's paper will be required for all homework assignments.

Transfer Information: (Please list colleges/majors that accept this course in transfer.)
University of Minnesota; University of Minnesota-Duluth; Minnesota State University, Mankato; St. Cloud State University; Michigan Technological University; North Dakota State University; University of North Dakota all accept for engineering majors.

Approvals:

Body	Representative Signatures	Date
Curriculum Committee	Kim Giermann	April 2, 2002
Faculty Association	Georgia Suoja	April 8, 2002
Meet and Confer	Dr. Jill Peterson	April 17, 2002
Chief Academic Officer	Dr. Jill Peterson	April 17, 2002

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