A. **TITLE:** Intermediate Fluid Mechanics  
B. **COURSE NUMBER:** MECH 341  
C. **CREDIT HOURS:** 3  
D. **WRITING INTENSIVE COURSE:** No  
E. **COURSE LENGTH:** 15 weeks  
F. **SEMESTER(S) OFFERED:** Fall  
G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY:**  
   3 lecture hours per week  
H. **CATALOG DESCRIPTION:**  
This course is an intermediate step in students understanding of fluid mechanics. Topics include fluid kinematics, Bernoulli’s equation, mass, energy, and momentum analysis of flow systems, internal flow, external flow, compressible flow, and differential analysis of fluid flows. The continuity, stream function, and Navier-Stokes equations are development for 2-D and 3-D flows. The introduction of similitude and dimensional analysis is also included.  
I. **PRE-REQUISITES/CO-REQUISITES:**  
   a. Pre-requisite(s): MECH 241 and junior level status or permission of the instructor.  
   b. Co-requisite(s): None  
J. **GOALS (STUDENT LEARNING OUTCOMES):**  
   By the end of this course, the student will be able to:  

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<th>Course Objective</th>
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| 1. Distinguish between streamlines, streaklines, pathlines, and timelines. | 1. Communication  
2. Critical Thinking |
| 2. Draw streamlines around objects such as turbines. | 1. Communication  
2. Critical Thinking |
| 2. Develop and understanding of the Bernoulli equation and its applications. | 1. Communication  
2. Critical Thinking |
| 3. Formulate the conservation of mass principle and apply to engineering systems. | 2. Critical Thinking |
| 4. Determine the forces acting on a control volume and apply them to Newton’s 2nd law. | 1. Communication  
2. Critical Thinking |
| 5. Apply Reynolds and other non-dimensional numbers in the solution of fluid problems. | 1. Communication  
2. Critical Thinking |
| 6. Apply dimensional analysis to experimental testing and modeling. | 1. Communication  
2. Critical Thinking |
| 7. Discriminate when to simplify the Navier-Stokes equations and demonstrate its proper use. | 2. Critical Thinking |
| 8. Develop the stream functions necessary to solve 2-D problems. | 2. Critical Thinking |
9. Analyze fluid flow in different situations such as annulus flow, rotating disc, and round tubes.

10. Explain the different types of drag associated with external flow and calculate drag and the point of flow separation.

11. Comprehend the fundamental concept of compressible flow and the development of shock waves.

10. Produce flow calculations around objects using a CFD package.

K. **TEXTS:**

L. **REFERENCES:** None

M. **EQUIPMENT:** None

N. **GRADING METHOD:** A-F

O. **MEASUREMENT CRITERIA/METHODS:**
   - Exams
   - Quizzes
   - Papers
   - Homework
   - Participation

P. **DETAILED COURSE OUTLINE:**
   I. Fluid Kinematics
      A. Newton’s Second Law
      B. Flow patterns and flow visualization
      C. Vorticity and rotationality
      D. Reynolds Transport Theorem
   II. Mass and energy analysis of flow systems
      A. Continuity equation
      B. Mechanical energy and efficiency
      C. Bernoulli equation
      D. Energy equation
   III. Momentum analysis of flow systems
      A. Linear and angular momentum
      B. Application of momentum equations
   IV. Dimensionless analysis
      A. Buckingham Pi Theorem
      B. Dimensionless groups
   V. Internal flows
      A. Characteristics of laminar and turbulent flow, wall friction, and pressure drop
      B. Flow rate and velocity measurements
   VI. Differential analysis
      A. Continuity equation
      B. Stream function
C. Navier-Stokes equations  
D. Flow between parallel plates  
E. Steady flow in round tube

VII. External flows  
   A. Boundary layer definition, flat plate friction, boundary layer thickness  
   B. Drag of bodies, lift of bodies  
   C. Friction vs. pressure drag

VIII. Compressible flow  
   A. Ideal gas relationship  
   B. Mach number and speed of sound  
   C. Isentropic flow  
   D. Non-isentropic flow  
   E. 2-D compressible flow  
   F. Rayleigh flow

Q. **LABORATORY OUTLINE:** None