Fluid Kinematics

1. **Course number and name:** 020CIFNI4 Fluid Kinematics

2. **Credits and contact hours:** 2 ECTS credits, 1x1:15 contact hours

3. **Name(s) of instructor(s) or course coordinator(s):** Cynthia Andraos

4. **Instructional materials:** PowerPoint slides; course handouts

5. **Specific course information**
   a. **Catalog description:**
      This course introduces the fundamental principles of fluid kinematics. It explores the motion and deformation of fluids without focusing on the forces that produce them. Topics covered include mathematical descriptions of fluid motion, streamlines, particle trajectories, velocity fields, deformation, and potential flows. The course emphasizes understanding of kinematic concepts and their application in the analysis of fluid flows.

   b. **Prerequisites:** 020STFNI2 Hydrostatics

   c. **Required/Selected Elective/Open Elective:** Required

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
      - Understand the basic concepts of fluid kinematics.
      - Mathematically describe the motion and deformation of fluids.
      - Analyze streamlines and particle trajectories in fluid flows.
      - Determine velocity fields and potential flows.
      - Apply kinematic concepts to analyze real fluid flows.
      - Develop problem-solving skills and critical thinking in the context of fluid kinematics.

   b. **PI addressed by the course:**

PI	1.2	1.3	6.4
Covered	x	x	x
Assessed	x	x	

7. **Brief list of topics to be covered**
   - Introduction to Fluid Kinematics
     - Fluid Properties Overview
     - Classification of Flows
     - Units and Dimensions

- Lagrangian and Eulerian Descriptions
  - Lagrangian Description
  - Eulerian Description
  - Difference between Lagrangian and Eulerian Descriptions
- Particle Derivative and Acceleration
  - Acceleration Field
  - Notation and Derivative
- Streamlines, Pathlines, and Streaklines
  - Introduction
  - Streamlines
  - Pathlines
  - Streaklines
- Translation, Rotation, and Deformation
  - Introduction
  - Translation without Deformation
  - Rotation
  - Linear Deformation
  - Shear Stress
- Conservation of Mass
  - Introduction
  - Mass Flow Rate and Volume Flow Rate
  - Principle of Mass Conservation
  - Special Cases
- Examples of Flows
  - Stream Function
  - Velocity Potential
  - Cauchy-Riemann Conditions
  - Complex Velocity Potential and Examples of Plane Flows