Fluid Mechanics

1. **Course number and name:** 020MEFGS2 Fluid Mechanics

2. **Credits and contact hours:** 6 ECTS credits, 3x1.25 hours

3. **Name(s) of instructor(s) or course coordinator(s):** Renalda EL-SAMRA

4. **Instructional Materials:**

    a. Class notes and slides by instructor

    b. White, F. (2015). Fluid Mechanics. 8th edition, McGraw-Hill

    c. Daugherty et al. (1985). Fluid Mechanics with Engineering Applications. 8th edition, McGraw-Hill

5. **Specific course information**
    a. **Catalog description:** Provides the fundamental elements for understanding incompressible fluid flow using mass, momentum and energy conservation principles. Resolution of the characteristic fluid flow equations through the application of analytical, numerical and analogous methods as well as reduced model techniques. Provides basic preparations for hydraulic engineering applications and studies.

    b. **Prerequisites or co-requisites:** 020CIFNI4 Fluid Kinematics or 020IMFCI4 Introduction to Fluid Mechanics – 020AN2NI4 or 020AN2CI3 Analysis 2

    c. **Required:** Required for all Civil Engineering students.

6. **Educational objectives for the course**
    a. **Specific outcomes of instruction:**

    By the end of the course, the students will:

    - understand the concepts of mass, momentum and energy conservation principles
    - know the methods and assumptions needed to describe quantitatively and analytically a fluid flow
    - be able to apply hydrostatic laws to calculate forces on surfaces
    - be able to use Bernoulli's equation to calculate pressures and velocities
    - be able to study an ideal fluid flow using potential flow theory
    - be introduced to the basics of numerical analysis and computational flow dynamics
    - know about dimensionless analysis and similitude
    - be familiar with the flow of real or viscous fluids
    - be able to identify different flow types and regimes

- be familiar with fluid flow applications through laboratory experiments.
- have basic scientific writing skills

b. PI addressed by the course:

PI	1.3	3.1	5.1	6.2	6.3	6.4
Covered	yes	yes	yes	yes	yes	yes
Assessed						

7. Brief list of topics to be covered:

1. Introduction & Review of basic mathematical formulations (1 session)

2. Integral Relations for a Control Volume (8 sessions)
   i. Mass conservation and continuity equation (2 sessions)
   ii. Conservation of linear momentum (2 sessions)
   iii. Conservation of angular momentum (2 sessions)
   iv. Conservation of energy (2 sessions)

3. Differential Analysis of Fluid Flow (6 sessions)
   i. Continuity equation (1 session)
   ii. Conservation of Momentum and Navier-Stokes Equations (3 sessions)
   iii. Conservation of energy or heat equation (2 sessions)

4. Fluid statics (6 sessions)
   i. Hydrostatic pressure (1 session)
   ii. Forces on inclined and curves surfaces (2 sessions)
   iii. Pressure distribution in rigid-body motion (2 sessions)
   iv. Overview of atmospheric stability (1 session)

5. Flow of an ideal or inviscid fluid (12 sessions)
   i. Euler equations of motion and Bernoulli's equation (3 sessions)
   ii. The stream function (2 sessions)
   iii. Potential flow theory, complex analysis and conformal mapping (5 sessions)
   iv. Fluid flow dynamics (2 sessions)

6. Dimensional analysis and similitude (4 sessions)
   i. Principle of dimensional homogeneity
   ii. The Pi-Theorem
   iii. Geometric and kinetic similitude

7. Flow of a real or viscous fluid (4 sessions)
   i. Viscosity measurements and Couette experiment
   ii. Reynolds experiment and Reynolds number
   iii. Laminar flows and velocity profiles

8. **Laboratory experiments (4 sessions)**
    i. Forces on plates
    ii. Venturi meter and Bernoulli's equation
    iii. Flow through an orifice
    iv. Viscosity measurements