



National University of Engineering (UNI)

School of Civil Engineering

Syllabus 2026-II

1. COURSE

CE3H1. Fluid Mechanics II (Mandatory)

2. GENERAL INFORMATION

2.1 Course	: CE3H1. Fluid Mechanics II
2.2 Semester	: 8 th Semester.
2.3 Credits	: 4
2.4 Hours	: 2 HT; 4 HP;
2.5 Duration of the period	: 16 weeks
2.6 Type of course	: Mandatory
2.7 Learning modality	: Face to face
2.8 Prerequisites	: CE2H1. Fluid Mechanics I. (7 th Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Fluid Mechanics II deepens the hydraulic analysis and design initiated in Fluid Mechanics I, covering three major blocks: pressurized pipe flow and pumping systems (including networks, transients, and modeling with specialized software), open channel flow (uniform flow, specific energy, rapidly and gradually varied flow, and modeling with HEC-RAS), and the design of hydraulic control structures (weirs, gates, inverted siphons, and culverts). The course combines classical analytical development with the use of hydraulic modeling tools (WaterCAD, HEC-RAS) employed in professional practice.

5. GOALS

- Analyze and design pressurized piping systems, including networks, pumps, and transient phenomena such as water hammer.
- Apply hydraulic modeling tools (WaterCAD, HEC-RAS) for the analysis of pipe networks and open channel flow.
- Analyze uniform and varied flow in open channels and design efficient and stable channel sections.
- Design hydraulic control structures such as weirs, gates, inverted siphons, and culverts.

6. COMPETENCES

- ABET-1)** An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (Usage)
- ABET-6)** An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (Usage)
- ABET-2)** An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. (Usage)

7. TOPICS

Unit 1: Pressurized Pipe Flow and Pump Systems (42 hours)	
Competences Expected: ABET-1,ABET-6	
Topics	Learning Outcomes
• Pipe flow fundamentals and Darcy-Weisbach equation • Minor losses and pipe system analysis • Pipe network analysis methods • Pump characteristics and system curves • Pump selection and installation requirements • Water hammer and surge analysis • Pipeline design and material selection • Variable speed pumps and energy efficiency • Network modeling and optimization • Valve selection and hydraulic control systems	• Calculate head losses in pipe systems using friction equations [Assessment] • Determine total head loss including minor losses in complex piping [Usage] • Analyze pipe networks using Hardy Cross or equivalent methods [Assessment] • Construct pump characteristic curves and system head curves [Usage] • Select appropriate pumps based on operating point and efficiency [Assessment] • Evaluate water hammer effects and design surge protection [Usage] • Design pipelines considering hydraulic, structural, and economic factors [Assessment] • Apply variable speed drives for pump system optimization [Usage] • Optimize water distribution networks using modeling software [Assessment] • Specify valves and control systems for pipeline operations [Usage]
Readings : [Whi16], [Ávi02]	

Unit 2: Open Channel Flow and River Mechanics (30 hours)	
Competences Expected: ABET-1,ABET-6	
Topics	Learning Outcomes
• Channel flow classification and hydraulic elements • Energy and momentum principles in open channels • Uniform flow and Manning's equation • Critical flow and specific energy concepts • Gradually varied flow profiles • Hydraulic jump and rapidly varied flow • Channel design for stable conveyance • Sediment transport in open channels • River morphology and channel stability • Scour analysis and protection measures	• Classify open channel flow regimes and calculate hydraulic elements [Familiarity] • Apply energy and momentum equations to solve channel flow problems [Assessment] • Calculate normal depth and discharge using Manning's equation [Usage] • Determine critical depth and analyze specific energy relationships [Assessment] • Compute gradually varied flow profiles using standard methods [Usage] • Analyze hydraulic jumps and calculate energy dissipation [Assessment] • Design stable channels with appropriate cross-sections and linings [Usage] • Estimate sediment transport rates in alluvial channels [Assessment] • Evaluate river channel stability and bank erosion potential [Familiarity] • Predict scour depths at hydraulic structures and design protection [Assessment]
Readings : [Cho59]	

Unit 3: Design of Hydraulic Structures (12 hours)	
Competences Expected: ABET-2	
Topics	Learning Outcomes
• Dam types and selection criteria • Spillway hydraulics and design • Weir and gate flow equations • Energy dissipation and stilling basin design • Culvert hydraulics and design • Dam safety analysis and risk assessment • Outlet works and control structures • Fish passage facilities and environmental hydraulics • Cavitation analysis and prevention • Physical hydraulic modeling and scale effects	• Classify dam types and select appropriate configurations for site conditions [Familiarity] • Design spillways for flood discharge capacity [Assessment] • Calculate discharge over weirs and through gates [Usage] • Proportion energy dissipation structures and stilling basins [Assessment] • Analyze culvert hydraulics for inlet and outlet control [Usage] • Perform dam safety evaluations and hazard classification [Assessment] • Design outlet works including intake structures and conduits [Usage] • Incorporate fish passage requirements in hydraulic structure design [Assessment] • Evaluate cavitation potential and design preventive measures [Usage] • Interpret physical model results and apply scale corrections [Assessment]
Readings : [Nov+07]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

***** EVALUATION MISSING *****

10. BASIC BIBLIOGRAPHY

- [Cho59] Ven Te Chow. *Open-Channel Hydraulics*. McGraw-Hill, 1959.
- [Ávi02] Gilberto Sotelo Ávila. *Hidráulica General, Tomo I: Fundamentos*. 2da. Limusa, 2002.
- [Nov+07] Pavel Novak et al. *Hydraulic Structures*. 4th. Taylor & Francis, 2007.
- [Whi16] Frank M. White. *Fluid Mechanics*. 8th. McGraw-Hill, 2016.