NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ENVIRONMENTAL ENGINEERING

SANITARY ENGINEERING PROGRAM

HH224 – FLUID MECHANICS II

I. GENERAL INFORMATION

CODE	**:**	HH224 Fluid Mechanics II
SEMESTER	**:**	6
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory, Practice)
PREREQUISTES	**:**	HH223 Fluid Mechanics I
CONDITION	**:**	Mandatory

I. COURSE INTRODUCTION

The Fluid Mechanics II is a subject of theoretical and practical nature. The subject begins with the study of Internal Flow. Energy losses in pipes and fittings, pipeline circuit in series and in parallel, pumping system and use of spreadsheets. Boundary Layer Theory: laminar boundary layer equations, turbulent boundary layer and applications in engineering. Compressible flow dynamics: adiabatic flow, shock wave, nozzles and diffusers, Fanno Flow and Rayleigh Flow, external flow, introduction to aerodynamics. Natural gas transportation: Application of the NTP, ASME B31.8 standards and use of spreadsheet for the design and calculation of external and internal natural gas networks.

II. COURSE OUTCOMES

At the end of the course, the students will be able to:

1. Design liquid transport systems using national (NTP) and international standards (ASME B31.8) and consideration of the technical-economic criteria and protection of the environment. Evaluate the use of materials for pipes, fittings, valves, measurement units and flow control. Select the drive, pump and engine team reflecting on existing literature and the experience of other engineers to make your project successful.
2. Use boundary layer theory in river, sea, land and air vehicles to:
   - Determine the drag force by action of the fluid.
   - Determine the power of the motor to be used.
   - Organize flow simulation in FLUENT software.
3. Design converging nozzles and divergent converging nozzles for industrial use, reflecting on the use of thermodynamic processes.
4. Design Natural Gas Transportation System, making use of NTP and relevant international standards justifying the use of materials in tubes, environmentally friendly accessories.

III. LEARNING UNITS

1. STUDY OF INTERNAL FLOW

Primary Loss and Secondary Losses / Series and Parallel Piping Systems / Applications and use of spreadsheet / Economic Diameter / Design of pumping systems.

2. BOUNDARY LAYER THEORY

Definition. Main equations / laminar boundary layer. / Boundary layer Thickness / Von Karman momentum equation / Turbulent regime boundary layer / Applications.

3. ONE-DIMENSIONAL COMPRESSIBLE FLOW

Introduction. Sound speed. Mach number. Reference states. Irreversible adiabatic flow with variable sectional area. Reversible adiabatic flow. Mass flow. Flow in nozzles and diffusers. Thermal efficiency. Applications. Shock wave. Subsonic and supersonic diffusers. Applications. Fanno flow and Rayleigh flow. Introduction to aerodynamics. Pumping systems.

4. TRANSPORT OF NATURAL GAS

Natura gas properties. Industrial facilities. Internal and external networks. Industrial networks. Transport of compressed air.

IV. METHODOLOGY

The course is developed in sessions of theory, practice and laboratory. In theory sessions, the teacher informs on concepts and applications. In the practical sessions, various problems are solved and analyze their solution and reflect on their use in other contexts.
The student must present and expose an integrative project: in the middle and at the end of the course. In all sessions, the active participation of the student is promoted and the cooperative work is used.

V. GRADING FORMULA

Grading System "F". Calculation of the Final Grade PF:

PF = (EP + 2 EF + PP) / 4

EP: Midterm Exam   EF: Final Exam   PP: Average of practical work

VI. BIBLIOGRAPHY

1. FLUID MECHANICS
Merle Potter and David Wiggert
International Thomson Editions

2. FLUID MECHANICS
Robert Mott
Pearson Education.