NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ENVIRONMENTAL ENGINEERING
SANITARY ENGINEERING PROGRAM

SA216 – WATER SUPPLY II

I. GENERAL INFORMATION

CODE	**:**	SA216 Water Supply II
SEMESTER	**:**	9
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory, Practice, Laboratory)
PREREQUISITES	**:**	SA215 Water Supply I
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

The course prepares students for the understanding and application of methods for the analysis and design of water supply systems. According to the characteristics of the water source, students analyze and design catchment structures, channels, conduction and driving lines, pumping stations and distribution networks. Student solve real world problem an design a complete water supply system for a given district of Lima city.

III. COURSE OUTCOMES

At the end of the course, students:

1. Analyze water sources regarding water quantity and quality, and determine the most appropriate hydraulic structure.
2. Design water channels satisfying given requirements and operation conditions.
3. Design pumping and piping systems, defining the tank volume and the specifications of the pump, pipes and valves corresponding to an economic solution.
4. Design water driving lines determining the diameter for investment minimization.
5. Design water distribution networks, determining the characteristics of the adduction line and the hydraulic operating conditions.
6. Plan and propose integral solutions to water supply problems using modern specialized software.

IV. LEARNING UNITS

1. WATER SUPPLY SOURCES AND CATCHMENT STRUCTURES

Supply sources. Types: surface, underground, sea. Source location and resource quantity and quality. Source selection. Catchment structures. Surface source: barrage, caisson and captive raft. Underground source: springs, filtering galleries, excavated and deep well.

2. CHANNELS

Classification. Channel section. Continuous, variable and uniform regime. Channel hydraulic characteristics. Channel design and evaluation. Sectional area of maximum hydraulic efficiency. Minimum infiltration efficiency. Construction costs. Operation costs. Evaporation and filtration loses.

3. CONDUCTION LINES

Evaluation of existing lines. Information for design. Characteristics of hydraulic lines. Piping hydraulic behavior. Series and parallel piping. Minimum cost design. Valves, types. Purge

valve. Air purge valve. Special valves. Conduction to several reservoirs. Reservoir automation. Design of conduction lines.

4. PUMPING STATIONS

Tank volume. Pumping equipment. Pump types: horizontal shaft, vertical shaft, submersible. Series and parallel pumps. Pump curves. Static and dynamic level. System curve. Suction and discharge tree. Pump selection. Required and available NPSH. Design of pumping stations.

5. DRIVE LINE AND ECONOMIC DIAMETER

Economic diameter. Bresse formula and other criteria. Piping class. Selection of economic diameter. Initial investment. Operation and maintenance costs. Water hammer. Valve of pressure relief. Automation of reservoir and pumping station. Drive line to several reservoirs. Design of driving lines.

6. DISTRIBUTION NETWORKS

Adduction line. Parallel piping. Network input pressure. Service areas. Distribution sectors. Matrix network. Filling network. Service flow. Pressure zones. Hardy Cross and design software. Pressure and flow diagrams. Results validation. Valves and hydrants.

V. PRACTICE WORK

Work 1. Pressure losses in conduction lines
Work 2. Pumping station
Work 3. Water distribution networks

V. METHODOLOGY

The course develops through theory, practice and laboratory sessions. In theory session, the instructor presents the concepts and methods. In practice sessions, students solve different problems related to water supply and consumption, pumping system, piping system, distribution networks. In laboratory sessions, students use hydraulic equipment for analysis of real cases. At the end of the course, students present and defend a water supply system design project.
Active student participation is encouraged throughput the course.

VI. EVALUATION FORMULA

The average grade PF is calculated as follows:

$$PF = (EP + 2\,EF + PC) / 4$$

EP: Mid term exam EF: Final exam
PC: Average of quizzes including final report

VII. BIBLIOGRAPHY

1. **WATER SUPPLY AND SEWERAGE SYSTEMS**
   McGuee Terence
   McGraw Hill Interamerican. Mexico
2. **PIPING HYDRAULICS**
   Saldarriaga Juan
   McGraw Hill Interamerican. Mexico
3. **MANUAL OF HYDRAULICS**
   Azevedo Netto, Acosta Alvarez
   McGraw Hill Interamerican. Mexico