NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ENVIRONMENTAL ENGINEERING
SANITARY ENGINEERING PROGRAM

SA235 – ANALYSIS OF WATER SOURCES AND NETWORKS

I. GENERAL INFORMATION

CODE	**:**	SA235 Analysis of Water Sources and Networks
SEMESTER	**:**	10
CREDITS	**:**	3
HOURS PER WEEK	**:**	5 (Theory, Practice)
PREREQUISITES	**:**	SA216 Water Supply II AA236 Computer Programming II
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

The course prepares students for the analysis and design of water supply networks. Students determine the hydraulic characteristics of water sources, project de future demand of water, determine demand density and zoning, and use this information for completing the design of a water supply network for a given city. Specialized software is used for designing and simulating the behavior of the network for different working conditions.

III. COURSE OUTCOMES

At the end of the course, students:

1. Analyze water sources, flow and pressure characteristics.
2. Project future water demand for different uses (domestic, industrial, etc.).
3. Design water distribution networks, dimensioning, selecting and integrating all of their components.
4. Simulate the behavior of the water distribution networks for different operating conditions, using specialized software.

IV. LEARNING UNITS

1. INTRODUCTION

Water sources. Types and characteristics. Water networks. Types. Scope.

2. WATER SOURCES AND WATER AVAILABILITY

Source types. Surface water. Under river flow. Groundwater. Frozen water. Desalination. Water uses. Drinkable water. Agriculture. Industry. Mining. Domestic. Recreation. Environmental. Projection of future water demand: population growing, economic grow by sectors.

3. WATER SUPPLY NETWORKS

Basic design parameters. Types of networks. Components of distribution networks, Primary and secondary networks. Classification of secondary networks. Population density, zoning and allocation. Pre-dimensioning of a matrix network. Considerations for the layout of a matrix network. Coding of system components. Consideration for the determining the flows at pressure nodes. Methods for computing the diameters of pressure pipes of matrix network. Design of an actual water network.

4. ANALYSIS AND SIMULATION OF WATER NETWORKS

Hydraulic computations. Practical formulas. Design methods and verification methods. Hardy Cross method with flow correction, with head correction. Linear methods and linearization. Newton Raphson method. Gradient-based methods.

Pipes, valves, and accessories. Reservoir, types. Head reservoir, Floating reservoir. Different forms of water distribution. Analysis of special cases.

5. NETWORK OPERATION AND MAINTENANCE

Construction and operation of distribution networks. SCADA systems. Networks maintenance. Preventive and corrective maintenance.

6. WATER STRESS

Population growth. Expansion of business activity. Rapid urbanization. Climate change. Depletion of aquifers. Pollution and water protection. Water shortage. Water and conflicts.

V. PRACTICE WORK

Along the course, students use specialized software for the analysis, design and simulation of water networks, completing the following activities:

- Estimation of water demand.
- Zoning, density and allocation.
- Delimitation of service area.
- Pressure zones and pressure nodes.
- Location of hydraulic components.
- Layout of matrix network.
- Coding of water network components.
- Pre-dimensioning of distribution network.
- Network design and simulation for different working conditions.
- Final report with planes.

V. METHODOLOGY

The course develops through theory, practice and computer laboratory sessions. In theory session, the instructor presents the concepts, principles and methods. In practice sessions, students solve different problems related to water distribution networks. In computer laboratory sessions, students use specialized software for completing the design of a water network for a given city in Peru. At the end of the course, students present and defend the 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 WASTEWATER REMOVAL**
   Fair, Geyer and Okun.
   Limusa Editions. Spain.

2. **WATER SUPPLY AND NETWORKS**
   Simon Arocha
   McGraw Hills

3. **PIPING HYDRAULICS**
   Juan Saldarriaga
   McGraw Hill Education