NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ENVIRONMENTAL ENGINEERING
SANITARY ENGINEERING PROGRAM

SA446 – WATER TREATMENT II

I. GENERAL INFORMATION

CODE	**:**	SA446 Water Treatment II
SEMESTER	**:**	10
CREDITS	**:**	4
HOURS PER WEEK	**:**	5 (Theory, Practice, Laboratory)
PREREQUISITES	**:**	SA445 Water Treatment II
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

The course prepares students for the understanding, analysis and design of water treatment plants for human consumption. Students identify different types of water treatment plants, understand the principles of filtration, the factors affecting the process, filtration means, quick filtration, and slow filtration process. Students experimentally determine the parameters of dosage, and pre-flocculation for direct filtration. Students also analyze and apply disinfection processes, characterize flows in water treatment plants, and assess the performance of water treatment plants. At the end of the course students complete the design of a water treatment plant with quick filtration systems and chlorination stations.

III. COURSE OUTCOMES

At the end of the course, students:

1. Distinguish the different filtration methods: quick, direct, slow.
2. Understand the principles and control parameters of drinkable water treatment: filtration and disinfection.
3. Experimentally determine optimal parameters of dosage, and pre-flocculation for direct filtration.
4. Design all units of a complete quick filtration plant using direct filtration: storage and dosage, quick mixing, flocculators, filtration and disinfection.
5. Apply methodologies for the assessment of quick filtration plants.

IV. LEARNING UNITS

1. WATER FILTRATION THEORY

Filtration fundamentals. Filtration mechanisms. Factors affecting the process. Fluidization theory. Expansion of filtration means. Washing velocity. Filtration unit types. Constant rate filtration units. Decaying rate filtration units.

2. DESIGN OF QUICK FILTRATION SYSTEMS. DIRECT FILTRATION PLANTS

Design criteria of quick filtration units: decaying rate and mutual washing. Direct filtration theory. Types of units. Methodology for experimental determination of direct filtration parameters.

3. SLOW FILTRATION PLANTS

Theory and mechanisms of slow filtration. Design criteria of slow filtration systems. Fundamentals of gravel pre-filtration. Construction of slow sand filtration systems: housing,

water layer, filtration bed, sand specifications, drainage system, flow control. Managing slow filtration systems.

4. DISINFECTION

Disinfection basics. Factors affecting the process. Disinfectants: chlorine, sodium hypochlorite, chlorine dioxide, chloramines, hydrogen peroxide, copper/silver ionization, bromine, ozone, UV. Chlorination. Factors affecting the process. Design criteria of chlorination systems.

5. ASSESSMENT OF WATER TREATMENT PROCESSES

Flow characterization. Analysis of retention periods. Use of tracers. Assessment methods. Managing chemical compounds. Quick mixing. Flocculation. Decantation. Filtration, Chlorination.

V. LABORATORY EXPERIENCES

1. Laboratory 1. Granulometric analysis of filtration means.
2. Laboratory 2. Determination of parameters of direct filtration.
3. Study visits to actual water treatment plants.

VI. METHODOLOGY

The course develops through theory, practice, laboratory and study visits sessions. In theory session, the instructor presents the concepts and methods. In practice sessions students, under the guidance of the instructor, apply concept and methods to solve different problems related to water treatment processes, in laboratory sessions students analyze the behavior and response of different filtration means, as well as the parameters of direct filtration methods. At the end of the course, students complete and present the design of quick filtration systems and chlorination stations. The report is orally defended. 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 TREATMENT FOR HUMAN CONSUMPTION, VOL 1.**
   Quick Filtering Plants.
   Panamerican Center for Sanitary Engineering and Environmental Sciences CEPIS, 2008
2. **WATER TREATMENT FOR HUMAN CONSUMPTION, VOL 2.**
   Plant Design.
   Panamerican Center for Sanitary Engineering and Environmental Sciences CEPIS, 2008
3. **WATER TREATMENT FOR HUMAN CONSUMPTION, VOL 3.**
   Slow Filtration Plants. Theory, Design, Operation, Maintenance and Control.
   Panamerican Center for Sanitary Engineering and Environmental Sciences CEPIS, 2008
4. **NATIONAL NORMS AND REGULATIONS – NORM OS.020**
   Water Treatment Plants for Human Consumption.
5. **DRINKING WATER QUALITY GUIDELINES**
   World Health Organization WHO.