# NATIONAL UNIVERSITY OF ENGINEERING
# COLLEGE OF ENVIRONMENTAL ENGINEERING
# SANITARY ENGINEERING PROGRAM

## SA465 – SEWAGE TREATMENT

### I. GENERAL INFORMATION

| | | |
|---|---|---|
| **CODE** | **:** | SA465 Sewage Treatment |
| **SEMESTER** | **:** | 10 |
| **CREDITS** | **:** | 4 |
| **HOURS PER WEEK** | **:** | 6 (Theory, Practice, Laboratory) |
| **PREREQUISITES** | **:** | SA245 Sewer and Fluvial Drainage<br>SA425 Unit Processes in Sanitary Engineering |
| **CONDITION** | **:** | Mandatory |

### II. COURSE DESCRIPTION

The course prepares students for the understanding, analysis and design of sewage and domestic residual water treatment plants. Students understand the topics of organic load, screening, and treatment technologies such as stabilization ponds, anaerobic and aerobic reactors, septic tanks, artificial wetlands, and advanced treatment process. Students also visit actual treatment plants for identifying the processes, components and evaluate their performance. At the end of the course students complete the design of a sewage treatment plant.

### III. COURSE OUTCOMES

At the end of the course, students:

1. Understand and apply different technologies for the treatment of domestic residual water.
2. Identify main chemical and biological components of domestic and industrial residual water.
3. Evaluate aerobic treatment processes, and design and operate aerobic treatment reactors fitted for the particular application.
4. Design and operate waste stabilization ponds for wastewater treatment.
5. Evaluate anaerobic treatment processes, and design and operate anaerobic treatment reactors fitted for the particular application.
6. Understand the characteristics of residual water in different parts of the country and select the proper technology for each particular case.
7. Apply water quality norms and regulations.

### IV. LEARNING UNITS

#### 1. INTRODUCTION TO SEWAGE TREATMENT

Characterization of residual water. Types of residual water. Legislation. Design and operation parameters. Nutrients. Diseases of water origin. Legislation.

#### 2. EVALUATION AND CONTROL OF WATER POLLUTION

Management of water resources. Fluvial system. Niño phenomena, characteristics. Deforestation and erosion. Water policies. Water general law. National Water Authority. Government Department of Housing, Construction and Sanitation. Government Department of Environment. Usage based water classification. Pollutants and pollution limits. Water conflicts. Mining and water pollution. Pollution control.

#### 3. COMPONENTS OF DOMESTIC RESIDUAL WATER

Water pollution. Pollution agents. Components of domestic residual water. Excreta and urine components. Organic load. Quality of residual water. Unit process and operations. Phase separation process.

**4. CONDITIONING OF RESIDUAL WATER FOR TREATMENT**

Screening. Phase separation process. Screening classification. Screen design criteria. Load loses by grills. Grill size. Relievers. Transition zones. Residual water daily volume. Grill chamber. Compensation tank.

**5. REACTORS**

Reactor principles. Batch reactors. Reactions and reaction kinetics. Piston flow reactor. Reynolds number. Complete mixing reactor. Recirculating piston flow reactor. Reactor comparison. Mass balance.

**6. AEROBIC TREATMENT**

Biological conversion processes. Heterotrophic and autotrophic bacteria. Nitrification. Nitrogen cycle. Advantages and limitations of aerobic treatment. Activated sludge. Trace elements un activated sludge. Sequential discontinuous reactor. Processes in activated sludge. Design criteria of activated sludge. Sedimentation rate. Bulk load. Sludge age. Aeration by diffusion. Diffusers. Blowers. Efficiency of oxygen transferring.

**7. STABILIZATION PONDS**

Principles of stabilization ponds. Primary and secondary ponds. Photosynthesis. Organic load. Advantages and disadvantages. Ponds classification. Anaerobic ponds. Acid fermentation. Methane genesis. Design criteria of stabilization ponds. Sulfur production. Substance transport through air, water and solid phase.

**8. ANAEROBIC REACTORS**

Bacterial hydrolysis. DQO balance. Types of anaerobic reactors. Anaerobic biodegradation. UASB reactors. Design criteria. Septic tank. Design criteria of septic tanks. Operation and maintenance. Waste management system.

## V. LABORATORY EXPERIENCES

1. Study visit to the Center for Research in Residual Water CITRAR.
2. Study visits to sewage treatment plants in Lima city.

## VI. METHODOLOGY

The course develops through theory, practice, and study visits sessions. In theory session, the instructor presents the concepts and methods. In practice sessions, students apply concept and methods to solve different problems related to sewage treatment processes. At the end of the course, students complete and present the design of a sewage treatment system. 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. **BIOLOGICAL WASTEWATER TREATMENT IN WARM CLIMATE REGIONS**
   De Lemos Chemicaro.
   International Water association.

2. **WASTEWATER ENGINEERING, TREATMENT AND REUSE**
   Metcalf and Eddy, Inc.
   McGraw Hill Editions.

3. **ANAEROBIC TREATMENT OF RAW DOMESTIC SEWAGE**
   Lettinga G, Roersma R. and Grin P.
   Department of Water Pollution Control, The Netherlands.