Wastewater Treatment Technology

3 academic credit hours (Two hour theoretical and one hour experimental)

Overview

This course is about wastewater treatment processes and technology, with an overview of the operation and maintenance of wastewater plants and different treatment processes. This course is intended to provide guidance and criteria for the design and selection of small-scale wastewater treatment plants. It provides both the information necessary to select, size, and design such wastewater treatment unit processes.

This subject will provide methods and technical issues related to integrated water services, treatment and reuse of water, with particular reference to urban areas, as well as an introduction to methods for the management and start-up of wastewater plants.

This course designed to achieve the following objectives:

1. advancing the students' knowledge in wastewater treatment systems and enhancing the principles of treatment plants design aspects.
2. Introduce fundamentals of the wastewater treatment plants and their unit operations and processes.
3. Provide basic design skills and knowledge on the wastewater treatment plants and their unit operations and processes.

Specific Goals

Students who successfully complete this course will be able to:

- Recognize the relationship between the natural water and human water use.
- Relate the physical, chemical and biological mechanisms and processes of water and wastewater constituents.
- Identify different types of reuse for the reclaimed water.
- Identify the suitability of the use of treated wastewater for irrigation and to evaluate the optimal method for the management of wastewater.
- Learn the sample handling, collection, quality control and analysis

Course Requirements

The course will include laboratory and field work (water sampling and field analysis), worksheets, exercises, readings, etc. In addition to participating in the lab and class discussions, students will have a midterm exam, the final exam will be a prototype treatment design.

Grade components
Attendance, participation, discussions 10%
Quizzes, Assignments, Readings 10%
Student project 10%
Midterm exam 10%
Laboratory work and reports 30%
Final exam 30%

Schedule

Lesson #	Topic
1	**An Overview:** **Features of the municipal wastewater** 1. Typical values of water demand - Residential water demand estimation - Domestic household wastewater effluents, sources and characteristic
2	**Features of the municipal wastewater** Typical values of water demand - Composition of the municipal wastewater - Physical features, - Biological features and - Chemical features) **Frank R. Spellman, Handbook of Water and Wastewater Treatment Plant Operations, (pages 46-55)**
3	**Features of the municipal wastewater** 1. Typical sewage flow rate values and the theory of simplified sewer design 2. Sanitary sewage design flow rates 3. Sustained peak flow rate and sustained minimum flow rate **Arcadio P. Sincero Sr., D.Sc., P.E., Physical chemical treatment of water and wastewater, First Edition, (pages 95-108 and 130-135)**
4	**Stages of wastewater treatment plant** Preliminary treatments, Primary treatment, Secondary treatment and Tertiary treatments. - Coagulation and flocculation - Sedimentation - Filtration - Disinfection and chlorination - Sedimentation and Flotation **Frank R. Spellman, Handbook of Water and Wastewater Treatment Plant Operations, (pages 492-497 and 503-508)**
5	**Stages of wastewater treatment plant** Preliminary treatments, Primary treatment, Secondary treatment and Tertiary treatments. - Trickling Filters - Rotating Biological Contactors - Activated Sludge - Stabilization Ponds

	Frank R. Spellman, Handbook of Water and Wastewater Treatment Plant Operations, (pages 349-354)
6	**Wastewater characteristics and effluent quality parameters** - Odor, color, turbidity, pH and EC - Hydrogen sulphide - Nitrogen (nitrification/denitrification) - Biological Phosphorus amendment - Potassium amendment **Arcadio P. Sincero Sr., D.Sc., P.E., Physical chemical treatment of water and wastewater, First Edition, (pages 144-147 and 149-160)**
7	**Wastewater pollution Load Estimation** - organic concentration - nutrient concentration - solids concentration
8	**Small scale wastewater treatment plant sequences** 1. Very Small Plants (Single Dwelling up to approximately 5cm/d) 2. Small Plants (5cm/d upto 20cm/d) 3. Medium Sized Plants (200cm/d upto 5000cm/d) 4. Large Plants (> 5000cm/d) **DJ Nozaic and SD Freese, Process Design Manual for Small Wastewater Works (pages 23-28)**
9	**Classification model:** selecting appropriate sanitation technology compatible with the community capacity
10	**Design parameters for water treatment plant units** - Initial prototype design **Shuokr Qarani Aziz et al., 2019. Step-by-step design and calculations for water treatment plant units. Advances in Environmental Biology 13(8): 1-16.**
11	**Design parameters for water treatment plant units** - Water Treatment Plant (WTP) Design flow rate capacity - Determining dimension of the cross section of the channel - Design considerations
12	**Guidelines, legislations and standards for effluent Reuse** - International and national guidelines of treatment and disposal - Wastewater treatment plant start-up strategies. - Technical issues related to agricultural reuse

Laboratory

The laboratory will provide hands-on experience in wastewater analytical skills. During the lab work, wastewater sampling from wastewater treatment plants will be taken, sampling methodology will be explained.

Lab 1	Safety manual - Lab safety policy & Interpreting Test Reports, Sampling and management
Lab2	- Flow rate and peek calculator - Simulator for municipal wastewater treatment systems
Lab 3	Tests needed to evaluate level of pollution (pH, EC, TDS)
Lab 4	Tests needed to evaluate level of pollution (NO3, NO2, NH4)
Lab 5	Tests needed to evaluate level of pollution (TPC, FC and TC)
Lab 6	Tests needed to evaluate level of pollution (BOD, TSS, TS)
Lab 7	Tests needed to evaluate level of pollution (COD)
Lab 8	Tests needed to evaluate level of pollution (Cl-, Cl_2, HCO_3)
Lab 9	Tests needed to evaluate level of pollution (Ca, Mg)
Lab 10	Step-by-step design and calculations for water treatment plant units

Text Book and reading documents:

1. Handbook of Water and Wastewater Treatment Plant Operations by Frank R. Spellman, LEWIS PUBLISHERS, CRC Press Company, Boca Raton London New York Washington, D.C. 2003
2. Physical chemical treatment of water and wastewater, First Edition, Arcadio P. Sincero Sr., D.Sc., P.E. Morgan State University, Baltimore, Maryland, Gregoria A. Sincero, M. Eng., P.E. Department of the Environment State of Maryland2003
3. Process Design Manual for Small Wastewater Works by DJ Nozaic and SD Freese, Water Research Commission, ISBN 978-1-77005-826-2, Printed in the Republic of South Africa. 2009.
4. Shuokr Qarani Aziz et al., 2019. Step-by-step design and calculations for water treatment plant units. Advances in Environmental Biology 13(8): 1-16. DOI:10.22587/aeb.2019. 13.8.1