

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

CENTER FOR WATER STUDIES 116 – ADVANCED WATER TREATMENT I

3 hours lecture, 3 units

Catalog Description

This course is a study of the basic principles involved in the theory, components, and operations of an Advanced Water Treatment Facility where reclaimed water is treated to augment potable water supplies and teach recycled water standards. Overview of treatment theory, design, operation, and monitoring, of components that complete an Advanced Water Treatment, multi barrier treatment facility.

Prerequisite

Any one of the following will satisfy the prerequisite for CWS 116:

- 1) Proof of a passing grade for the SWRCB T2 Water Treatment certification exam
- 2) Possession of a valid SWRCB T2 (or Higher) Water Treatment certification
- 3) Proof of a passing grade for the SWRCB Grade 2 Wastewater Treatment certification exam
- 4) Possession of a valid SWRCB Grade 2 (or higher) Wastewater Treatment certification

Course Content

- 1) Introduction to Advanced Water Treatment Operations
 - a. Review of water cycle from potable supply reservoirs to Wastewater treatment of Title 22 reclaimed water
 - b. Introduction to Advanced Water Treatment, pure water multi barrier treatment system
 - c. Review of pathogens, disinfection, water quality regulations and standards in the water treatment cycle
- 2) Basics of Ozone Disinfection
 - a. Ozone in potable water augmentation
 - b. Reaction of ozone in wastewater treatment
 - c. Ozone demand and decay
 - d. Ozone equipment
- 3) Basics of Biological Activated Filtration, Granular Activated Filtration systems and pretreatment requirements of Membrane Filters
 - a. Granular activated carbon and biological activated carbon
 - b. Organic contaminants & compounds removed by adsorption
 - c. BAC filter media performance
 - d. Design parameters for BAC filters
- 4) Basics of Micro Filtration, Ultra-Filtration, Nano Filtration systems and pretreatment requirements of the Reverse Osmosis system
 - a. Membrane Filtration Treatment Theory
 - b. Micro filtration, ultra-filtration, Nano filtration dead end flow pattern
 - c. Membrane configuration
 - d. Application in water reuse
 - e. Fouling and Scaling
 - f. Components and configuration
 - g. Pressure driven & Submerged membrane systems
 - h. Common system equipment/ components
- 5) Basics of Reverse Osmosis system and pretreatment requirements of the Ultra Violet Disinfection system

- a. Reverse Osmosis introduction
 - b. RO application in water treatment
 - c. RO Equipment
 - d. RO system instrumentation, monitoring process/performance indicators
 - e. Chemical dosing, system recovery, system flux
 - f. Salt passage, net driving force, differential pressure
 - g. RO safety
- 6) Basics of Ultraviolet light irradiation for disinfection
- a. Introduction to Ultra Violet light
 - b. Forms of Electro Magnetic Radiation
 - c. UV categories and wavelengths
 - d. UV light in water treatment
 - e. UV lamps
 - f. UV disinfection of pathogens
 - g. UV photolysis
- 7) Basics of Advanced Oxidation Process for enhancement of cell photolysis and water disinfection
- a. Sodium Hypochlorite, Hydrogen Peroxide, & Ozone
 - b. Photolysis breakdown of oxidants
 - c. Water Quality influence on AOP
 - d. AOP components

Course Objectives

Students will be able to:

- 1) Define common terminology pertaining to advanced water treatment operations system components and design.
- 2) Identify the types and functions of multi-barrier systems used in advanced water treatment operations system design.
- 3) Describe the function of a BAC filter and how it is useful in the pretreatment of MF & UF multi-barrier systems.
- 4) Describe the basic cleaning methods of backwashing and clean in place for advanced water treatment operations system.
- 5) List and describe the components of an advanced water treatment operations system.

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

- 1) Participation in classroom discussions
- 2) Homework assignments
- 3) Quizzes and exams
- 4) Projects and assignments utilizing the Field Operations Skills Yard

Special Materials Required of Student

None

Minimum Instructional Facilities

Smart classroom

Method of Instruction

- 1) Lecture and discussion
- 2) Multimedia presentations
- 3) Field trips
- 4) Demonstrations utilizing the Field Operations Skills Yard

Out-of-Class Assignments

- 1) Reading assignments
- 2) Writing assignments

Texts and References

- 1) Required (representative example): *Membrane Processes for Water Reuse; Anthony M. Wachinski. McGraw Hill, 2013. ISBN-13: 978-0071748957, ISBN-10: 0071748954*
- 2) Supplemental: None

Exit Skills

Students having successfully completed this course exit with the following skills, competencies and/or knowledge:

- 1) Describe Advanced Water Treatment system components.
- 2) Describe how Ozone disinfection is different than Chlorine disinfection.
- 3) Describe the Biological Activated Carbon filtration system and how it is different from conventional water treatment filtration.
- 4) Perform basic mathematical calculations related to ozone system disinfection
- 5) Describe basic safety procedures of the ozone destruct systems and why they are required by the regulatory agency.

Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- 1) List the 6 multi barrier processes in an Advanced Water Treatment facility
- 2) Describe the water cycle from reservoirs to Title 22 Wastewater reclamation and define the need of water recycling and conservation
- 3) Explain what irreversible fouling is and how it is detrimental to the reverse osmosis system
- 4) Recognize and elaborate on common terms and acronyms used in Advanced Water Treatment Operations