**WTR 104 Course Outline as of Fall 2017**

# CATALOG INFORMATION

Dept and Nbr: WTR 104 Title: CHEM/LAB DRNK WTR TRTMNT
Full Title: Chemistry and Lab Principles for Drinking Water Treatment
Last Reviewed: 1/26/2015

| Units | | Course Hours per Week | | Nbr of Weeks | Course Hours Total | |
|---|---|---|---|---|---|---|
| Maximum | 1.50 | Lecture Scheduled | 1.00 | 17.5 | Lecture Scheduled | 17.50 |
| Minimum | 1.50 | Lab Scheduled | 1.50 | 8 | Lab Scheduled | 26.25 |
| | | Contact DHR | 0 | | Contact DHR | 0 |
| | | Contact Total | 2.50 | | Contact Total | 43.75 |
| | | Non-contact DHR | 0 | | Non-contact DHR | 0 |

Total Out of Class Hours: 35.00 Total Student Learning Hours: 78.75

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| Title 5 Category: | AA Degree Applicable |
| Grading: | Grade Only |
| Repeatability: | 00 - Two Repeats if Grade was D, F, NC, or NP |
| Also Listed As: | |
| Formerly: | ENVT 104 |

**Catalog Description:**
This course is designed for water treatment operators and covers general chemistry and laboratory practices specific to drinking water. The course will provide both a lecture and laboratory component covering topics such as proper sampling procedures, safety in the water treatment plant, unit conversions, dosage and dilution calculations, bacteriological analysis methods, chlorine breakpoint analyses, using and calibrating portable and on-line turbidimeters, and jar testing for evaluating chemical dosages. This class will prepare students for the laboratory procedures portion of the Department of Public Health T2 operator examination.

**Prerequisites/Corequisites:**
Course Completion of WTR 102

**Recommended Preparation:**

**Limits on Enrollment:**

**Schedule of Classes Information:**
Description: This course is designed for water treatment operators and covers general chemistry and laboratory practices specific to drinking water. Prepares students for the laboratory

procedures portion of the Department of Public Health T2 operator examination. (Grade Only)
Prerequisites/Corequisites: Course Completion of WTR 102
Recommended:
Limits on Enrollment:
Transfer Credit:
Repeatability: Two Repeats if Grade was D, F, NC, or NP

## ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

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| **AS Degree:** | **Area** | Effective: | Inactive: |
| **CSU GE:** | **Transfer Area** | Effective: | Inactive: |
| **IGETC:** | **Transfer Area** | Effective: | Inactive: |

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| **CSU Transfer:** | Effective: | Inactive: |
| **UC Transfer:** | Effective: | Inactive: |

**CID:**

**Certificate/Major Applicable:**
Certificate Applicable Course

## COURSE CONTENT

**Outcomes and Objectives:**
1. Identify the chemical formulas and calculate the molecular weights of common water treatment chemicals.
2. Perform unit conversions between various types of measurement for concentrations, flows, and pressures.
3. Estimate the dosage of a chemical addition to water during a treatment process.
4. Calculate the new concentration after a dilution has been performed, and estimate the best dilution to achieve a desired outcome.
5. Define and identify normal operating ranges for the following parameters: pH, free and total chlorine turbidity, alkalinity, hardness, and fluoride concentration.
6. Compare bacteriological methods to determine the most appropriate laboratory method to be performed.
7. Compare laboratory analytical data to allowable maximum contaminant limits to decide if the drinking water meets California standards.
8. Estimate the chlorine demand of a water given a chlorine breakpoint titration graph and differentiate between the different areas of the titration curve.
9. Recommend a coagulant dosage based on the turbidity results of a jar test.
10. Determine the best sampling location and recognize necessary laboratory holding times, chain-of-custody procedures and preservation techniques.
11. Measure total and free chlorine residuals in drinking water samples.
12. Calibrate and utilize pH/temperature meters, portable turbidimeters, and on-line turbidimeters.
13. Perform jar testing to propose appropriate coagulant dosages.
14. Perform and interpret bacteriological presence/absence and enumerated bacteriological results for their own use.
15. Classify common water treatment chemicals into acids, bases, oxidizers, etc. using material

safety datasheets.
16. Predict chemical incompatibilities based on chemical classifications.
17. Recognize signs of chlorine gas leaks.
18. Define the primary concepts necessary to meet the expected range of knowledge for a T2 operator.

**Topics and Scope:**

I. General Chemistry
  A. Lecture
    1. Periodic Table
    2. Elements and molecules
    3. Common Water Treatment Plant Chemical Formulas and Molecular Weights
    4. Writing Chemical Equations
    5. Unit Conversions and Temperature Scales
    6. Acids, Bases, pH
    7. Calculating Chemical Dosages
    8. Performing Dilutions
    9. Chemical Sampling Procedures
    10. Safety in the Laboratory and Water Treatment Plant
  B. Laboratory: Calibrating and performing pH measurements
II. Bacteriological Methods
  A. Lecture
    1. Proper sampling methods and holding times
    2. Dechlorination
    3. Presence/absence test method
    4. Multiple tube fermentation method
    5. Heterotropic Plate Count
    6. Membrane Filtration Method
    7. Presumptive vs. Confirmed Results
  B. Laboratory
    1. Presence/Absence test
    2. Enumerated bacteriological test
III. Chlorine and Fluoride
  A. Lecture
    1. Normal chlorine levels
    2. Chlorine Analysis Techniques (DPD, amperometric)
    3. Chlorine Breakpoint Analysis
    4. Chlorine gas leaks and safety issues
    5. Normal fluoride levels
  B. Laboratory
    1. Chlorine residual analyzer use
    2. Chlorine breakthrough titration example
IV. Turbidity
  A. Lecture
    1. Turbidity Defined
    2. Review Hach NTU manual
    3. Types of equipment, on-line, scatter, portable
    4. Acceptable turbidity ranges for each filtration type
  B. Laboratory
    1. Calibration and use of portable turbidimeter
    2. Calibrate and use of on-line turbidimeter

V. Coagulation/Filtration
  A. Lecture
    1. Calculating Dosages
    2. Concept of Zeta Potential
    3. Determine Optimal Coagulant Dosage
    4. Removing TOC, taste and odor and color
  B. Laboratory: Jar Testing Example
VI. Alkalinity/Hardness
  A. Lecture
    1. Definitions
    2. Impacts on Coagulation
  B. Laboratory
    1. Setting up Calibration Cylinder and Use
    2. Calculating Dosages

**Assignment:**

1. Reading: approximately 10 - 30 pages per week, based on an eight week course.
2. Problem solving homework: 3 assignments (2 on general chemistry, 1 on dosage calculations.
3. Laboratory skill demonstrations: 3 demonstrations (calibration and use of turbidimeter, pH analyzer, and chlorine analyzer including determination of an unknown)
4. Weekly quizzes on previous week's material.
5. Final Exam: Laboratory Demonstration

**Methods of Evaluation/Basis of Grade:**

**Writing:** Assessment tools that demonstrate writing skills and/or require students to select, organize and explain ideas in writing.

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| None, This is a degree applicable course but assessment tools based on writing are not included because problem solving assessments and skill demonstrations are more appropriate for this course. | Writing<br>0 - 0% |

**Problem Solving:** Assessment tools, other than exams, that demonstrate competence in computational or non-computational problem solving skills.

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| Homework problems | Problem solving<br>25 - 35% |

**Skill Demonstrations:** All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

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| Laboratory demonstrations; Final lab demonstration | Skill Demonstrations<br>30 - 40% |

**Exams:** All forms of formal testing, other than skill performance exams.

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| Multiple choice, True/false, Completion, Problems, Short Answer | Exams<br>30 - 40% |

**Other:** Includes any assessment tools that do not logically fit into the above categories.

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| None | Other Category<br>0 - 0% |

**Representative Textbooks and Materials:**
Basic Chemistry for Water and Wastewater Operators, Darshan Sarai;  American Waterworks Association, Revised edition 2005
Drinking Water Chemistry: A Laboratory Manual, Barbara Houser; CRC Press, 2001
Instructor prepared materials