WWTR 122 Course Outline as of Fall 2012

CATALOG INFORMATION

Dept and Nbr: WWTR 122 Title: WASTEWATER CHEMISTRY
Full Title: Wastewater Chemistry
Last Reviewed: 2/13/2023

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	3.00	Lecture Scheduled	2.00	17.5	Lecture Scheduled	35.00
Minimum	3.00	Lab Scheduled	3.00	17.5	Lab Scheduled	52.50
		Contact DHR	0		Contact DHR	0
		Contact Total	5.00		Contact Total	87.50
		Non-contact DHR	0		Non-contact DHR	0

Total Out of Class Hours: 70.00 Total Student Learning Hours: 157.50

Title 5 Category:	AA Degree Applicable
Grading:	Grade or P/NP
Repeatability:	00 - Two Repeats if Grade was D, F, NC, or NP
Also Listed As:	
Formerly:	ENVT 122

Catalog Description:
This course will cover basic wastewater laboratory information, including chemical terms and symbols, equipment, sampling, safety, and quality assurance. Students will perform lab tests, including pH, dissolved oxygen, solids (settleable, suspended, total, volatile), sludge volume index, biological and chemical oxygen demand, alkalinity, hardness, turbidity, chlorine residual, and total coliform bacteria.

Prerequisites/Corequisites:
Course Completion of WWTR 120 (or ENVT 120 or ENVT 220 or ENVT 320 or ENVT 220)

Recommended Preparation:

Limits on Enrollment:

Schedule of Classes Information:
Description: This course will cover basic wastewater laboratory information, including chemical terms and symbols, equipment, sampling, safety, and quality assurance. Students will perform lab tests, including pH, dissolved oxygen, solids (settleable, suspended, total, volatile), sludge volume index, biological and chemical oxygen demand, alkalinity, hardness, turbidity, chlorine

residual, and total coliform bacteria. (Grade or P/NP)
Prerequisites/Corequisites: Course Completion of WWTR 120 (or ENVT 120 or ENVT 220 or ENVT 320 or ENVT 220)
Recommended:
Limits on Enrollment:
Transfer Credit:
Repeatability: Two Repeats if Grade was D, F, NC, or NP

ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

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

CSU Transfer:	Effective:	Inactive:
UC Transfer:	Effective:	Inactive:

CID:

Certificate/Major Applicable:
Both Certificate and Major Applicable

COURSE CONTENT

Outcomes and Objectives:
Upon completion of the course, students will be able to:
1. Apply an understanding of basic wastewater chemistry to wastewater treatment processes.
2. Demonstrate use and care of laboratory equipment.
3. Define and identify types of samples collected for wastewater laboratory.
4. Analyze and determine if proper levels of treatment, content of acidity/alkalinity, hardness and other water quality characteristics have been achieved for wastewater.
5. Perform tests including pH, dissolved oxygen, solids (settleable, suspended, total, volatile), sludge volume index, bio logical oxygen demand, and chemical oxygen demand, alkalinity, hardness, turbidity, jar test, chlorine residual, total suspended solids, mixed liquor suspended solids, total coliform bacteria.
6. Apply laboratory safety techniques to the use of common laboratory equipment.
7. Describe the relevance of chemical tests to the operation of a wastewater treatment plant.

Topics and Scope:

I. Introduction
   A. Laboratory Safety
   B. Use of emergency equipment
   C. Techniques for handling toxic or dangerous chemicals
   D. Right-To-Know information: manufacturer’s safety data sheets (MSDSs)
   E. Care and use of analytical instrumentation
   F. Reagent-grade chemicals and reagent-grade lab water

II. Review of Lab Terminology

A. Periodic table of elements
B. Definition of concentrations
C. Commonly used equipment (overview)
D. Quality assurance and quality control
E. Collection, preservation, and holding times for samples
F. Reporting of results (Method Detection Limits)
G. Significant figures

III. Physical Examination Tests
A. pH-related tests
1. pH: electrode and indicator methods
2. Acidity: hydroxide titration method
3. Alkalinity: acid titration method
B. General Physical
1. Color: Nessler comparison method
2. Odor: threshold odor number method
3. Turbidity: nephelometric method
C. Conductivity: specific at 25EC
D. Coagulation: jar test method
E. Corrosivity: saturation and langelier indices
F. Hardness: total and calcium EDTA titration methods
G. Tempurature: thermometric method
H. Solids (Residue) Methods
1. Total solids and percent solids: oven-dried at 104EC
2. Total dissovled solids (TDS): oven-dried and baked at 180EC
3. Total suspended solids (TSS): oven-dried at 104EC
4. Volative and fixed solids: charred at 550EC
5. Settleable solids: Imhoff cone method

IV. Inorganic Non-Metallic Constituents
A. Methods of analysis
1. Colorimetry: Beer-Lambert's Law
2. Titrations
3. Ion chromatography
4. Packaged test kits
B. Chlorine Residual
1. Free chlorine
2. Combined chlorine
3. Iodometric titration method
4. Amperometric titration method
C. Chloride: argentometric and mercuric nitrate methods
D. Bromide: ion chromatographic method
E. Sulfate: turbidimetric method
F. Cyanides: distillation/colorimetric method
G. Sulfides: methylene blue method
H. Dissolved oxygen: Winkler and electrode methods
J. Ozone: indigo standard method (ISE)
K. Nitrogen chemistry
1. Ammonia: distillation, then ISE, colorimetric, or titration methods
2. Nitrite: colorimetric method
3. Nitrate: cadmium reduction and ion chromatographic methods (ICP)
4. Organic nitrogen: Kjeldahl nitrogen method

L. Boron: curcumin or ICP methods

V. Inorganic Metallic Constituents
- A. Toxic metals: cause and effect
- B. Common inorganic metals in waters
- C. Methods of analysis: choosing detection limits
  1. ICP-AES
  2. ICP-MS
  3. Graphite furnace AAS
  4. Flame AAS
  5. Cold vapor AAS
  6. Hydride-generation AAS

VI. Microbiological Examination
- A. Water and wastewater regulations
- B. Total and fecal coliform testing methods
  1. MPN - multiple tube fermentation
  2. Membrane filter
  3. Presence - absence
- C. Heterotrophic plate count (HPC) testing methods
  1. Standard plate count
  2. Research methods (R2A, NWRI, etc.)

VII. Aggregate Organic Constituents
- A. Biochemical oxygen demand (BOD): 5-Day test
- B. Chemical oxygen demand (COD): closed reflux colorimetric methods
- C. Total organic carbon (TOC): UV oxidation and combustion methods
- D. Oil and grease: partition-gravimetric method
- E. Phenols: colorimetric 4-AAP method
- F. Surfactants: MBAS extraction method

VIII. Individual Organic Constituents
- A. Constituents and EPA methods
  1. Trihalomethanes (THMs)
  2. Volatile organic compounds (VOCs)
  3. Pesticides, herbicides
  4. Disinfection by products (DBPs)
  5. Polychlorinated biphenyls (PCBs)
  6. Polynuclear aromatic hydrocarbons (PAHs)
  7. Dioxin
- B. Special sampling protocols
- C. Preparation and analytical methods
  1. Purge and trap preparation method
  2. Liquid-liquid extraction preparation method
  3. Gas chromatography (GC)
  4. Gas chromatography-mass spectrometry (GC-MS)
  5. High pressure liquid chromatography (HPLC)

IX. Fish Toxicity and Related Bioassays
- A. Acute toxicity
- B. Chronic toxicity
- C. Other bioassays

X. Sludge Analyses
A. Mean cell residence time (MCRT): calculation
B. Sludge settleables: cylinder method
C. Sludge volume index (SVI): calculation
D. Food to microorganism ratio (F/M ratio): calculation
E. Volatile acidity of digester sludge: distillation method
F. Alkalinity of digester sludge: acid titration method
G. PH of digester sludge: electrode method
H. Microbiological count of activated sludge: microscope counting method

Assignment:

1. Reading: approximately 10 - 30 pages per week.
2. Problem solving homework: 3-5 assignments
3. Laboratory skill demonstrations: 3-5 demonstrations
4. Weekly quizzes on previous week's material.
5. Laboratory activities (15) and notebooks
6. Final Exam

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.

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 0 - 0%

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

Homework problems, Lab activities, Lab notebooks	Problem solving 15 - 30%

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

Lab Skill Demonstrations	Skill Demonstrations 30 - 40%

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

Quizzes; final exam.	Exams 40 - 55%

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

None	Other Category 0 - 0%

Representative Textbooks and Materials:
1. Laboratory Procedures and Chemistry for Operators of Water Pollution Control Plants, by Dr. Kenneth Kerri (for the California Water Pollution Control Association), 1991 (classic)
2. Instructor prepared materials