STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK

MASTER SYLLABUS

COURSE NUMBER – COURSE NAME
CONS 386 - Water Quality

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Canino School of Engineering Technology

Department: Civil and Construction

Technology Semester/Year: Fall 2018

A. **TITLE**: Water Quality

B. **COURSE NUMBER:** CONS 386

C. **CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)**

 # Credit Hours: 4
 # Lecture Hours: 3 **per week**
 # Lab Hours: (1) three-hour lab **per week**
Other: **per week**

Course Length: 15 **Weeks**

D. **WRITING INTENSIVE COURSE**: Yes ☐ No ☒

E. **GER CATEGORY: None:** ☒ **Yes:** GER
***If course satisfies more than one*:** GER

F. **SEMESTER(S) OFFERED: Fall** ☒ **Spring** ☐ **Fall & Spring** ☐

G. **COURSE DESCRIPTION:**

Water is one of Earth's most valuable resources. The quality of water is essential to human health, the environment, and industrial/engineering use. This course provides students with the knowledge to determine the quality of water and how it is impacted by contaminants. Course content expands upon concepts of basic chemistry to study areas of aqueous chemistry that relate to water quality analysis. Specific topics include the physical, chemical, and biological characteristics of water and the significance and interpretations of water quality properties. The fate of contaminants in natural and engineered environments are studied. Environmental and engineered systems are modeled in order to study contaminant fate and reaction kinetics. Laboratory sessions use standard water quality testing practices that are currently used in industry.

H. **PRE-REQUISITES: None** ☐ **Yes** ☒ **If yes, list below:**

MATH 161 (Calculus I), CHEM 150 (College Chemistry I), or permission of the instructor.

CO-REQUISITES: None ☒ **Yes** ☐ **If yes, list below:**

I. STUDENT LEARNING OUTCOMES: (*see key below*)

By the end of this course, the student will be able to:

Course Student Learning Outcome [SLO]	***Program Student Learning Outcome [PSLO]***	***GER*** *[If Applicable]*	***ISLO & SUBSETS***	
a. Explain the roles and responsibilities of public institutions and private organizations that relate to water and wastewater quality	2488: 9b		5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
b. Calculate concentrations and do unit conversions	2488: 2ab		5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
c. Apply key concepts of equilibrium chemistry: equilibrium constants, activity, ionic strength, and solubility products	2488: 1a, 2ab, 4b, 6b		2-Crit Think ISLO ISLO	PS Subsets Subsets Subsets
d. Establish a water sampling plan	2488: 1a, 3ab, 4b, 7b, 11c		5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
e. Measure common water and wastewater quality parameters: pH, temperature, dissolved oxygen, turbidity, color, solids analysis, alkalinity, hardness, acidity.	2488: 1a, 2ab, 3a, 5b, 6ab, 7bc, 11a		5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
f. Conduct other water and wastewater tests for inorganic pollutants (metals - iron), organic pollutants (biochemical oxygen demand, BOD), and microbial contaminants	2488: 1ab, 2ab, 3ab, 6ab, 7bc, 11ac		5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets

(HPC plate count and coliform presence/absence test)				
g. Analyze and interpret water quality data	2488: 2ab, 3ab, 6ab, 7cd, 10		2-Crit Think ISLO ISLO	PS Subsets Subsets Subsets
h. Apply acid/base chemistry to water quality problems.	2488: 1a, 2abc, 6ab		5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
i. Demonstrate knowledge of mass balance concepts and conduct mass balance related analysis	2488: 1a, 2ab		5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
j. Research a topic related to the course by conducting a technical literature review and prepare a written deliverable (standard report, fact sheet, or poster) and present the research findings to the class in an oral presentation.	2488: 7abcd, 8b, 9ab, 10, 11ad		5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets

KEY	**Institutional Student Learning Outcomes [ISLO 1 – 5]**
ISLO #	**ISLO & Subsets**
1	**Communication Skills** Oral [O], Written [W]
2	**Critical Thinking** *Critical Analysis [CA] , Inquiry & Analysis [IA] , Problem Solving [PS]*
3	**Foundational Skills** *Information Management [IM], Quantitative Lit,/Reasoning [QTR]*
4	**Social Responsibility** *Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]*
5	**Industry, Professional, Discipline Specific Knowledge and Skills**

*Include program objectives if applicable. Please consult with Program Coordinator !

J. APPLIED LEARNING COMPONENT: Yes ☒ No ☐

If YES, select one or more of the following categories:

- ☒ Classroom/Lab
- ☐ Internship
- ☐ Clinical Placement
- ☐ Practicum
- ☐ Service Learning
- ☐ Community Service
- ☐ Civic Engagement
- ☐ Creative Works/Senior Project
- ☐ Research
- ☐ Entrepreneurship (program, class, project)

K. TEXTS:

"Water and Wastewater Technology" by Mark J. Hammer and Mark J. Hammer Jr., Pearson Prentice Hall, 7th edition, 2008, ISBN 9780135114049.

L. REFERENCES:

Droste, Ronald L. (1997). Theory and Practice of Water and Wastewater Treatment. New York, New York: John Wiley & Sons, Inc.
Stumm, Werner and Morgan, James J. (1996). Aquatic Chemistry, 3rd edition. New York, New York: Wiley Interscience, , John Wiley & Sons, Inc..
vanLoon, Gary W. and Duffy, Stephen J. (2000). Environmental Chemistry a Global Perspective. New York, New York: Oxford University Press.
Drever, James I. (1997). The Geochemistry of Natural Waters, 3rd edition. Upper Saddle River, New Jersey: Prentice Hall.
Langmuir, Donald (1997). Aqueous Environmental Geochemistry. Upper Saddle River, New Jersey: Prentice Hall.
Talaro, Kathleen Park (2005). Foundations in Microbiology, 5th edition. New York, New York: McGraw Hill Higher Education.
Tchobanoglous and Schroeder (1985). Water Quality. Reading, Massachusetts: Addison Wesley Logman.

M. EQUIPMENT: None ☐ **Needed:** Laboratory equipment, provided by the department will include, but is not limited to:

- Standard, regular use laboratory equipment and materials: beakers, graduated cylinders, sample collection bottles, BOD bottles, support stands and clamps, mixing plates, pipets, safety gloves, deionized water
- pH probes and dissolved oxygen probes
- Turbidimeter
- Alkalinity and hardness titration equipment
- Solids analysis equipment
- Filtration equipment
- Colorspectrophotometer and reagents
- Microbial analysis equipment
- Reactor design equipment

N. GRADING METHOD: A-F

O. SUGGESTED MEASUREMENT CRITERIA/METHODS:

- **Examinations,**
- **Laboratory exercises,**
- **Homework assignments,**
- **In-class exercises,**
- **Quizzes**
- **Paper and Presentation**

P. DETAILED COURSE OUTLINE:

I. Introduction

II. Basic Chemistry
A. Isotopes
B. Compounds
C. Chemical formulas of Ionic Compounds
D. Chemical equations of reactions
E. Data Analysis

III. Basic Water Quality Parameters
A. pH
B. Temperature
C. Dissolved Oxygen
D. Turbidity
E. Total Dissolved Solids
F. Conductivity

IV. Data Analysis
A. Mean, median

B. Measuring spread, variability, and distribution

C. Displaying and analyzing data
1. Stemplot
2. Box plots / whisker plots
3. Histograms
4. Scatter plots
5. Inference and significance/variance tests
6. Excel in data analysis

V. Other Physical Characteristics of Water
A. Solids Analysis
B. Taste and Odor

VI. Expressing Concentration
A. % volume and % mass
B. Mass concentration
C. Parts Per Million
D. Molality
E. Molarity

F. Normality
G. Mole Fraction
H. Mass Concentration
I. Unit Conversions

VII. Chemical Characteristics of Water
A. Inorganic Chemical Constituents
1. Major ion Analysis
2. Hardness and Alkalinity
3. Acidity
4. Metals and redox reactions
5. Nutrients (nitrogen and phosphorus ions)

B. Equilibrium Chemistry
1. Equilibrium constants
2. Ionic Strength, Activities, Solubility Products

C. Acid-Base Chemistry
1. Dissociation of acids and bases
2. Acid-base calculations for pH
3. The Carbonate System

D. Organic Chemical Constituents
1. Natural Organic Compounds
2. Synthetic Organic Compounds
3. Measurement of Organic Matter

VIII. Biological Characteristics of Water
A. Basic concepts of microbiology
B. Microbial Constituents
1. Bacteria
2. Protozoa
3. Eukaryotes
4. Algae
5. Fungi
C. Microbial Growth
D. Measuring Bacteria

IX. Environmental Reaction Kinetics
A. Flow Regimes
1. Batch Reactor
2. Continuously stirred tank reactor
3. Plug flow reactors
B. Reaction Kinetics
1. Types of reactions
2. Zero-order reactions
3. First-order reactions
4. Second-order reactions
C. Mass Balance
1. Reaction rates
2. Batch Reactor

3. Continuously Stirred Tank Reactors
4. Plug Flow Reactors
5. Other Reactors
D. Tracer Studies
E. Mass Transport Equations

X. Environmental Fate
A. Modeling natural systems and tracer studies
B. Mass Transport
F. Saturation Constants
G. Partition Coefficients
H. Mass transfer

Q. <u>LABORATORY OUTLINE</u>: None ☐ Yes ☒

1. Water and Wastewater Regulating Bodies, Regulations, and Standards
2. Sampling Techniques, Field/Laboratory Safety, and Analysis of Basic Water Quality Parameters I (pH and temperature)
3. Field Sampling and Analysis of Basic Water Quality Parameters II (DO, turbidity, color)
4. Solids Analysis
5. Alkalinity, Acidity, and Hardness
6. Metals Testing Lab Part I: Sampling and Analysis Plan, field testing, and sample collection
7. Metals Testing Lab Part II: Laboratory metals analysis
8. Nutrient Analysis (phosphates, sulfates, nitrates, nitrites) Part I: field testing and sample collection
9. Nutrient Analysis Part II: laboratory testing
10. Biochemical Oxygen Demand (BOD)
11. Microbial Analysis: Determination of Heterotrophic Bacteria and Coliforms
12. Mass Balance and Reactor Design
13. Field Trip to Potsdam Water Treatment Plant
14. Student Project Presentations