SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: ADVANCED WASTEWATER TREATMENT

CODE NO: WTR 327-5 **SEMESTER:** VI

PROGRAM: WATER RESOURCES/ENVIRONMENTAL ENGINEERING TECHNOLOGY

AUTHOR: SUBHASH VERMA, P.ENG.

DATE: APRIL 1995 **PREVIOUS OUTLINE DATED:** FEBRUARY 1992

APPROVED; DEAN DATE

ADVANCED WASTEWATER TREATMENT **WTR 327-5**

COURSE NAME **CODE NO.**

TOTAL CREDIT HOURS: 80

PREREQUISITE(S): WTR 226

I. PHILOSOPHY/GOALS:

To present basic knowledge and practices, theories, and applications relevant to the wastewater treatment of wastewaters. The course work will involve biological, physical and chemical processes, and sludge treatment and disposal methods. The objectives of the course and the course outline are given on the attached.

II. STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student will be able to:

1. Identify the physical, chemical and biological characteristics of wastewater.
2. Classify treatment processes with respect to the method and degree of treatment, and sludge handling.
3. Determine sludge characteristics and estimate the guantities of sludges.
4. Classify the sludge treatment process and to estimate the volume of sludge digesters.
5. Determine the capacity of egualization basins.
6. Calculate the nutrient loading due to waste discharges from municipal and industrial plants.
7. Perform calculations related to deoxygenation of stream water.
8. Calculate assimilative capacity of a given water system using an elementary water guality model.

II. STUDENT PERFORMANCE OBJECTIVES: (CONT'D)

9. Describe the various physical, chemical and biological processes for phosphorous and nitrogen removal.

10. Perform design calculations for physical treatment processes, including sedimentation, thickening, flotation, filtration, centrifugation, adsorption and membrane separation.

11. Perform design calculations for chemical treatment processes, including neutralization, coagulation, ion exchange, oxidation and disinfection.

12. List and describe the treatment methods for industrial wastes including food, pulp and paper, steel and chemical industries.

III. TOPICS TO BE COVERED:

1 Review of Treatment Processes (Chapter 12)

1.1 Definition and classification

1.2 Activated Sludge Process variations

1.3 Factors affecting Activated Sludge Process

1.4 Process control and Operational parameters

2 **Processing of Sludges (Chapter 13)**

2.1 Sources, Characteristics and Quantities of Waste Sludges

2.2 Arrangement of Unit Processes in Sludge Disposal

2.3 Sludge Digestion

2.4 Vacuum and Pressure Filtration

ADVANCED WASTEWATER TREATMENT **WTR 327-5**

COURSE NAME **CODE NO.**

III. TOPICS TO BE COVERED: (CONT'D)

3 Water Quality and Pollution (Chapters 15, 8)

3.1 Stream Loading

3.2 Types and Sources of Stream Pollution

3.3 Aeration and Deoxygenation of Stream Waters

3.4 An Elementary Water Quality Model

4 Pre-Treatment of Industrial Waste

4.1 Neutralization

4.2 pH Adjustment

4.3 Hydroxide Precipitation

4.4 Metal Precipitation

5 Development of Headworks Loadings

5.1 Definition and Purpose

5.2 Derivation of Local Limits

5.3 Allocation of Loadings

6 Advanced Wastewater Treatment Processes (Chapter 14)

6.1 Effluent Standards and Flow Equalization

6.2 Selection of Advanced Wastewater Treatment Processes

6.3 Granular Media Filtration

ADVANCED WASTEWATER TREATMENT **WTR 327-5**

COURSE NAME **CODE NO.**

III. TOPICS TO BE COVERED: (CONT'D)

6.4 Carbon Adsorption

6.5 Phosphorus Removal

6.6 Nitrogen Removal

6.7 Wastewater Reclamation

7 Industrial Waste Treatment Process (Project)

7.1 Food Industry

7.2 Pulp & Paper

7.3 Steel and Mining

7.4 Chemical

7.5 Auto

7 .6 Petroleum

IV. EVALUATION METHODS: (INCLUDES ASSIGNMENTS, ATTENDANCE REQUIREMENTS ETC.)

Laboratory & Field Exercises, Project	25%
Three Unit Tests	75%

GRADING:

A+- 90-100%
A - 80- 89%
B - 70- 79%
C - 60- 69%

A passing grade will be based on a minimum composite grading of 60%,

ADVANCED WASTEWATER TREATMENT **WTR 327-5**

COURSE NAME **CODE NO.**

V. REQUIRED STUDENT RESOURCES

Water Supply ^ Pollution Control, by Warren Viesman, Jr. and Mark J. Hammer. 5th Edition, Harper and Row Publishers, New York. (1993).

Course Manual by S. Verma, Sault College

VI. ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY BOOKSECTION:

Wastewater Treatment, by Donald W. Sundstrom and Herbert E. Klei, Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. (1979).

Water and Wastewater Technology (SI Version) by Mark J. Hammer. John Wiley & Sons, (1987), 2nd edition.

Industrial Water Pollution - Origins, Characteristics and Treatment, by Nelson L. Nemerson. Addison-Wesley Publishing Company, Don Mills, Ont. (1978).

Water Quality, by George Tachobanoglous and Edward D. Schoreder. Addison-Wesley Publishing Company, Don Mills, Ontario. (1985).

VII. SPECIAL NOTES:

Students with special needs (e.g. physical limitations, visual impairments, hearing impairments, learning disabilities) are encouraged to discuss required accommodations confidentially with the instructor.

Your instructor reserves the right to modify the course as he/she deems necessary to meet the needs of students.

ADVANCED WASTEWATER TREATMENT **WTR 327-5**

COURSE NAME **CODE NO.**

VIII. ADDITIONAL NOTES

The following laboratory experiments/exercises are planned:

1. Process evaluation and control of an activated sludge process.

2. Study the characteristics and quantities of primary, secondary and processed sludges.

3. Acidity/Alkalinity of anaerobic digesting sludge.

4. Study the design and operation of sludge digesters.

5. Determine the ultimate BOD for a given wastewater sample.

6. Determine the BOD curve for a given sample using a respirometer, and hence calculate the reaction rate constant.

7. Compute the maximum oxygen deficit (critical) in a stream receiving wastewater using simple water quality model.

8. Study the phosphorus removal efficiency with and without chemical treatment.

9. Trace nitrogen in a secondary plant with and without significant nitrification.

NOTE:

Reports are due one week after an exercise is performed. Late submissions will be penalized.