SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: WATER CHEMISTRY

Code No.: CHM 230-4

Program: PULP & PAPER/WATER RESOURCES ENGINEERING TECHNOLOGY

Semester: THREE

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New: _____ Revision: X

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Chairperson Date

CALENDAR DESCRIPTION

WATER CHEMISTRY	CHM 230-4
COURSE NAME	COURSE NUMBER

PREREQUISITE: CHM 218-4

PHILOSOPHY/GOALS: This course is an introduction to the chemistry of natural and polluted waters. The concepts taught in CHM 230 will be applied in later courses dealing with water and wastewater treatment. The purpose of such a course is to provide students with a knowledge of what pollutants are likely to be found in the water and some of the typical analyses that are done on a routine basis.

The student will develop his/her ability to communicate effectively by completing a formal laboratory report on each analysis performed.

In addition to the compulsory labs, additional topics include the following: Phosphate, Flouride, Kjeldahl Nitrogen Gas Solubility, etc.

GRADING METHOD (EVALUATION):

Theory - Mid Term Test]		NOTE: There is no supplemental
- Final Exam]	50%	exam or re-write as such.
- Assignment(s)]		
		Theory work during the term is
Lab - 6 labs	50%	25% of final grade.

All assignments and labs must be submitted the day they are due. Late assignments will not be marked, while late lab assignments lose 10% per week for lateness.

The following rule applies to attendance: **ALL STUDENTS ARE REQUIRED TO ATTEND 80% OF THEORY CLASSES AND 100% OF LAB CLASSES UNLESS A PRIOR ARRANGEMENT WITH THE INSTRUCTOR HAS BEEN OBTAINED.**

TEXTBOOK(S):

Braun, Introduction to Chemical Analysis. McGraw-Hill, 1982.

W/W 80 Procedures and Test Equipment for Water/Wastewater Analyses. (Fisher Scientific, 1983.)

Sampling for Water Quality Environmental Control.

Water Quality Sourcebook. Environment Canada. 1979.

INTRODUCTION:

CHM 230 is a continuation of the Analytical Concepts begun in CHM 218 (Semester 2). However, CHM 230 focuses on water quality parameters in both theory and lab parts of the course. The course involves two hours of theory per week and a lab each week. A total of five labs are required for the course. These include the following: Acidity, Alkalinity, pH, D.O., B.O.D., C.O.D., Hardness, Conductivity, and Turbidity, plus an experiment of the student's choice.

UPON COMPLETION OF THIS COURSE, THE STUDENT WILL BE ABLE TO:

1. Using the production of SO_2 as a by-product from smelting and/or electrical generation, be able to calculate the amount of SO_2 produced from burning of coal containing X% S, - write equation and make calculations regarding control methods such as scrubbing (limestone, magnesium oxide), Cat-ox, etc.

2. Using typical data from a water analysis, calculate the hardness and alkalinity and express the result in mg/L as $CaCO_3$.

3. Draw mEq./L bar graphs, list the hypothetical combinations, and determine concentrations of these combinations, given typical water analysis data. Discus analytical data as to whether or not it is acceptable.

4. Discuss water hardness, its two types, the difference between each, the cause of each and the method by which each can be reduced.

5. Calculate T-AlK, P-AlK, M-AlK.

6. Explain the key points regarding alkalinity.

7. Make calculations involved in determining water acidity and pH.

8. Calculate the pH of a $NaHCO_3$ solution.

9. Graph the data from a potentiometric titration, including first and second derivative plot to determine the cell emf at the end point.

10. Collect water samples in the approved manner and treat these samples for later laboratory analysis. See pp. 2-37 for sampling of water quality.

11. Discuss and explain the rationale for the presence of various controversial chemicals (Kepone; Mirex; 2-, 4-D; 2-, 4-, 5-T; Dioxin; Radionuclides, etc.) and explain the concern for their use, their affect on the environment, etc.

12. Make calculations involved with the determination of D.O. (Azide method), $B.O.D._5$, and C.O.D. in samples collected from the area.

    D.O. - Root River
    $B.O.D._5$ - Sewage Plant Effluent (Primary)
    C.O.D. - Algoma Steel (Settling Pond)

13. Explain the various types of analytical instrumentation that are used in Water Analyses and what they are for:

    A.A. - Metallic ions
    G.C. - Organics
    H.P.L.C. - Organics
    etc.

14. Discuss the various water quality parameters according to the following classifications:

    a) Physical characteristics
    b) Dissolved gases
    c) Metals
    d) Organics
    e) Radionuclides

15. Discuss the chemistry of Iron and Manganese as it relates to water chemistry.

16. Explain the effect aeration has on water quality and how it can affect odour and colour.

17. Make calculations for and be able to prepare standard solutions as required.

18. Prepare calibration curves and determine the best fit line.

19. Select the correct instrumentation for chemical analysis.

20. Use the terms found in the glossary of Sampling of Water Quality, pp. 50-54 as relating to water sampling.

TIME FRAME (Wks)		
	Acidity - 3	Alkalinity - 2
	Hardness - 1	DO/COD/BOD - 3
	Instrumental - 2	Miscellaneous - 4

FORMAT FOR LABORATORY REPORTS

1. All pages of the lab book should be numbered. Do this as soon as you purchase it. Number at the middle of the bottom of the page.

2. Page 1 is used for your name, address, course number for which the lab book is to be used and any additional information.

3. The next three pages are used for a Table of Contents or Index. This is to be completed as you complete your experiment.

4. Each experiment is to be documented using the following format:

A. Table of Contents

B. Exp. # Title of Experiment Starting Date

C. Prelab:
   - Apparatus required to perform this experiment.
   - Chemicals to be used in this experiment.
   - Any hazards that should be noted regarding the chemicals used.
   - Solutions required in this experiment. Calculations showing preparation of 1 L of the solution is to be shown.

D. Objectives:
   - These must be written in a manner which indicates what you are attempting to do. Example - To prepare 1 L of a 0.1M NaOH solution using NaOH pellets.
   - Each objective is to be numbered.
   - Each objective begins with "To".
   - Each objective must be measurable by the instructor.

E. Abstract:
   - This is composed of one or more paragraphs.
   - Total length is 50-250 words.
   - Briefly explains what you did in the experiment.
   - Gives the results that you obtained.
   - Compares your results with known values, etc.
   - Includes statistical analysis of data.

F. Procedure:
   - Usually a reference to where the method comes from.
   - Includes any differences that you make from the prescribed method.
   - Full reference is required.

G. Theory:
   - Is written in your own words.
   - Gives the theoretical basis for the method used.

- Derives all equations used, mathematical as well as chemical.
- Must be written in complete sentences and paragraphs.
- All terms must be defined in theory.

H. Data:
- Is to be in table format.
- Must be logical and flow smoothly from statement to statement.
- Must include all data collected and calculated values.
- Correct number of significant figures must be maintained.

I. Calculations:
- A sample calculation showing the result must be included.
- Mathematical equation used must be shown.
- Simple arithmetic steps need not be shown.
- All statistical analysis must be shown, eg. mean, precision, standard deviation, etc.
- Graphs of data and of results where pertinent.

J. Discussion of Results and Source of Errors:
- Results must be discussed with regards to precision and accuracy.
- Compare results to known values.
- Express relative error when using unknown.
- Source of error must be discussed as to how it applies to your experiment.
- All graphs must be discussed.

K. Conclusions:
- Are keyed to objectives.
- Each objective requires a conclusion.
- Must be complete.

L. Bibliography:
- Fully referenced.
- Includes all books, journals, etc. used in the preparation of report.

M. Sign the end of your report and date it showing date completed.

Notes: All data collected in the lab is to be recorded on the left hand side of the page. This is your rough data. It is to be recorded neatly. Data must not be recorded on slips of paper.

The report is to be written only on the right hand pages. Graphs may be on the left hand pages if necessary.

POSSIBLE 6TH EXPERIMENTS FOR CHM 230

1. Volumetric determination of t-Fe using $K_2 Cr_2 O_7$.
2. Determination of Calcium and Magnesium using AAS.
3. Volumetric determination of Water Hardness.
4. Spectrophotometric analysis of nitrites.
5. Fluoride analysis using specific Ion electrode.
6. Sulphate analysis using turbedemetric method.
7. Determination of Iron Spectrophotometrically.
8. Spectrophotometric determination of phosphate.
9. BOD of an Industrial Effluent.
10. Acidity of an Industrial Wast Effluent.
11. Bioassay - Toxicity study.
12. Volumetric determination of sulphide.
13. Solubility of O_2 as a function of temperature.