Grande Prairie Regional College

DEPARTMENT OF SCIENCE

CHEMISTRY 2120 (1993-94)

INSTRUCTOR:	Dr. Som K. Pillay (Office: E 309; Tel: 539-2985)
PREREQUISITE:	CHEM 1000, CHEM 1040 or equivalent
TRANSFER CREDITS:	U. of Alberta: CHEM 212, 6 Credits U. of Calgary: CHEM 410, 6 Credits
LECTURES:	MONDAYS, WEDNESDAYS & FRIDAYS 1:00 - 1:50 P.M. (J 229)
LABORATORY:	FRIDAYS 2:00 - 5:50 P.M. (J 119)
TEXT BOOKS AND LABORATORY ITEMS:	*Quantitative Chemical Analysis*, Third Edition, Daniel C. Harris, W. H. Freeman and Company, 1991. *Chemistry 212, Quantitative Analysis*, B. Kratochvil and W. E. Harris, University of Alberta, 1993. A Hard-Covered Laboratory Notebook, Lab Coats and Safety Glasses.

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COURSE EVALUATION

Assignments/Quizzes	20.0%
Lab Work	40.0%
Mid-Term Examination(December)	10.0%
Final Examination(April)	30.0%
	100.0%

Grade	Marks(%)	Grade	Marks(%)
9	85-100	5	59-64
8	79-84	4	50-58
7	72-78	3	45-49
6	65-71	2	36-44

Quizzes:

There will be ten quizzes/term. The first quiz will be on Friday, September 24, 1993 and will be part of the practical test. Quizzes will be about fifteen minutes in length and will cover assigned readings, lectures, experiments, and problems. Absence from a quiz requires a **valid excuse.** Absence due to illness must be substantiated by a **written report** from a physician.

COURSE OUTLINE

1. INTRODUCTION AND REVIEW:

Introduction to Course, Units, Expressions of Concentration, Analytical Balance and Weighing, Buoyancy Correction, Calibration of Volumetric Glassware

Chapters: 1 & 2
Lab Manual Sections: I, II & III

2. EXPERIMENTAL ERROR:

Significant Figures, Systematic Error, Random Error, Precision and Accuracy, Absolute and Relative Uncertainty, Propagation of Uncertainty

Chapter: 3

3. STATISTICAL ANALYSIS:

Gaussian Error Curve, Standard Deviation and Probability, Variance, Chi-Square Test, Student's t, Confidence Intervals, Comparison of Means, Dealing with Bad Data, Method of Least Squares

Chapter: 4
Lab Manual Sections: IV & V

4. PRINCIPLES OF VOLUMETRIC ANALYSIS:

Precipitation Titrations, Mass Titrations, Titration of Mixtures, End-Point Detection

Chapter: 9

5. **ACID BASE EQUILIBRIA:**

Review of Fundamentals, The Dissociation Constant, Conjugate Acids and Bases, pH, Strong Acids and Bases, Weak Acids and Bases, Fraction of Dissociation, Buffers, Henderson-Hasselbalch Equation, Buffer Capacity, Polyprotic Acids and Bases, Amino Acids

Chapter: 5, Sections 5.1, 5.6 - 5.8
Chapter: 10

6. **ACID BASE TITRATIONS:**

Strong Acid with Strong Base, Weak Acid with Strong Base, Weak Base with Strong Acid, Titrations in Diprotic Systems, Titration Curves, End Point, Indicators

Chapter: 11

7. **ADVANCED TOPICS IN ACID BASE CHEMISTRY:**

Fractional Composition Equations, Isoionic and Isoelectric Points

Chapter: 12, Sections 12.1 - 12.3

8. **COMPLEXATION EQUILIBRIA:**

Metal Chelate Complexes, EDTA Complexes, Formation Constant, Titration Curves, Auxiliary Complexing Agents, Metal Ion Indicators, EDTA Titration Techniques

Chapter: 13

9. **ELECTROCHEMISTRY:**

Review of Fundamentals, Galvanic Cells, Standard Potentials, Nernst Equation, Relation of E° and the Equilibrium Constant

Chapter: 14

10. REDOX TITRATIONS:

Redox Titration Curve, Titration of Mixtures, Redox Indicators

Chapter: 16, Sections 16.1 - 16.3

11. POTENTIOMETRY:

Reference Electrodes, Indicator Electrodes, Junction Potential, Ion-Selective Electrodes, pH Measurement with a Glass Electrode

Chapter: 15, Sections 15.1 - 15.6

12. POLAROGRAPHY:

Ohmic Potential, Concentration Polarization, Overpotential, Polarography, Shape of the Polarogram

Chapter: 17, Section 17.2
Chapter: 18, Sections 18.1 & 18.2

13. SPECTROPHOTOMETRY:

Properties of Light, Absorption, Emission, Fluorescence, Beers Law, The Spectrophotometer, Serum Iron Determination, Spectrophotometric Titrations, Luminescence

Chapter: 19, Sections 19.1 - 19.5, 19.7, & 19.10
Chapter: 20, Sections 20.1 - 20.3

14. ATOMIC SPECTROSCOPY:

Instrumentation, Background Correction, Sensitivity and Detection Limit, Analytical Methods, Interference

Chapter: 21

15. INTRODUCTION TO SEPARATIONS:

Solvent Extraction, Gas Chromatography, High-Performance Liquid Chromatography, Ion-Exchange Chromatography, Molecular Exclusion Chromatography

Chapter: 22; Sections 22.1 & 22.3
Chapter: 23; Sections 23.1 - 23.6

LECTURE SESSION

Regular attendance of lectures is essential to achieve a good understanding of the course material. You are encouraged to ask questions and to participate in class discussions. Help is also available outside the class room. NO APPOINTMENTS ARE NEEDED.

TENTATIVE LECTURE SCHEDULE

FALL SEMESTER

WEEK OF	MONDAY	WEDNESDAY	FRIDAY
Sept.6	NO LECTURE	Introduction	Analytical Balance
13	Volumetric Glassware	Volumetric Glassware	Experimental Error
20	Statistical Analysis	Statistical Analysis	Titration Theory
27	Titration Theory	Determination of Chloride	Determination of Acid Mixture
Oct. 4	Analysis of Acid Mixture Data	Determination of Ca & Mg	Determination of Benzimidazole
Oct. 11	NO LECTURE	Acids & Bases	Acids & Bases
18	Titration of Cu^{2+}	Acids & Bases	Buffers
25	Ethylene Glycol Titration	Buffers	Diprotic Acids
Nov. 1	Fractional Compositions	Acid-Base Titrations	Acid-Base Titrations
Nov. 8	Acid-Base Titrations	Acid-Base Titrations	Diprotic Titrations
15	Diprotic Titrations	Endpoint Indicators	Complexation Equilibria
22	Complexation Equilibria	Complexation Titrations	Auxiliary Ligands
29	Fundamentals of Electrochemistry	Electrochemistry	Electrochemical Cells
Dec. 6	Redox Titrations	Redox Titrations	END OF CLASSES
13	CHRISTMAS	EXAM	*

WINTER SEMESTER

WEEK OF	MONDAY	WEDNESDAY	FRIDAY
Jan. 3	NO LECTURE	Determination of Total Salt	Determination of Trace Iron
10	Determination of Trace Iron	Determination of Glucose	Determination of Trace Cu (AA)
17	GC & LC Experiments	GC & LC Experiments	Solvent Extraction
24	Radiochemistry	Potentiometry	Potentiometry
31	Determination of Fluoride	Potentiometry	Polarography
Feb. 7	Polarography	Spectrophotometry	Beer's Law
14	Literature Search	UV-VIS Instrumentation	Fluorescence Spectroscopy
21	NO LECTURE	WINTER BREAK	WINTER BREAK
28	Beer's Law Deviations	Applications of UV-VIS	Fluorescence
Mar. 7	Fluorescence	Atomic Spectroscopy	Atomic Spectroscopy
14	Atomic Spectroscopy	Separations	Separations
21	Supplementary Calculations	Chromatography	Chromatography
28	Gas Chromatography	Gas Chromatography	Liquid Chromatography
Apr. 4	Liquid Chromatography	Ion Exchange Chromatography	Size Exclusion Chromatography
11	REVIEW	REVIEW	END OF CLASSES
18	FINAL EXAM	FINAL EXAM	FINAL EXAM

READING AND PROBLEM ASSIGNMENTS

Problem solving will guide your study in the right direction and also will help you to monitor your performance in the course.

Approximately five to ten questions will be assigned as homework every week. However, you are encouraged to solve as many additional problems as you can. It is important that you work out these problems independently. Seek help with the ones you cannot solve yourself. Unless instructed otherwise, assignments are due on Fridays at 1:00 P.M. NO LATE ASSIGNMENTS ARE ACCEPTED. DON'T ASK!

FALL SEMESTER

PROBLEM SET #	CHAPTER*	PROBLEMS
1	1 & 2	1-8, 1-15, 1-18, 2-2 to 2-6 and 2-11
2	3 & 4	3-2, 3-8, 3-10, 4-2, 4-4, 4-6, 4-7, and 4-15
3	9	9-2, 9-3, 9-5, 9-10, 9-16 and 9-19
4	5 & 10	5-H, 5-I, 5-K, 10-B, 10-D, 10-J, 10-K, 10-13, 10-15, 10-17, 10-21, 10-23, and 10-28 to 10-30
5	11	11-6, 11-8 to 11-10, 11-16, 11-19, and 11-23
6	11 & 12	11-35, 11-36, 12-2, 12-12, and 12-14
7	13	13-3 to 13-5, 13-10, 13-12, 13-18, 13-20, 13-22 and 13-27
8	14	14-4, 14-6, 14-15, 14-19, 14-21, 14-22, 14-24, and 14-27
9	14 & 16	14-36, 14-44, 16-2, 16-9, 16-12, 16-18, and 16-20

*TEXT: *Quantitative Chemical Analysis*, Third Edition, Daniel C. Harris, W. H. Freeman and Company, 1991.

WINTER SEMESTER

PROBLEM SET #	CHAPTER*	PROBLEMS
10	15	15-1 to 15-3, and 15-10 to 15-12,
11	15	15-18, 15-19, 15-23, 15-25, 15-27, and 15-34
12	19	19-E, 19-1, 19-3, 19-8, 19-9, 19-22, and 19-24 to 19-26
13	20	20-1, 20-3, 20-11, 20-12, 20-14, and 20-16
14	21	21-1 to 21-3, 21-6, and 21-8
15	22	22-1 to 22-3, 22-6, 22-7, and 22-9
16	22	22-11, 22-13, 22-23, 22-30, and 22-32
17	23	23-1, 23-2, 23-6, 23-13, 23-19, and 23-23
18	23	23-26, 23-27, 23-29, 23-32, 23-34, and 23-41

*TEXT: *Quantitative Chemical Analysis*, Third Edition, Daniel C. Harris, W. H. Freeman and Company, 1991.

LABORATORY SESSION

Laboratory sessions start at 2:00 P.M. sharp. All students are expected to come to the laboratory well prepared for the experiment that is to be performed and on time. It is a requirement of the course that you complete the assigned work within the allotted amount of time. Fairness demands that all students receive the same amount of lab time. For this reason, students are not permitted to work past 5:50 P.M., and the lab must be vacated by 6:00 P.M. **This rule is enforced without exceptions.**

Students are expected to attend all laboratory periods. Absence due to illness must be substantiated by presenting suitable evidence to the Instructor/Lab Technician. An opportunity to make up a lab will be given only for **excused absence.**

The laboratory experiments are designed to allow a well-prepared student to finish all the work within the allotted time. **IT IS YOUR RESPONSIBILITY TO COMPLETE THE LAB ON TIME.**

LABORATORY REPORT:

You must record everything you do and observe as you carry out your experiment. Use a hard-cover laboratory note book for this purpose. Do not copy the procedure from the laboratory manual. Keep your note book neat. Your notebook will be checked periodically and graded.

The first term lab assignment comprises six analyses and must be completed in nine four-hour lab periods. You are expected to hand-in the results for two analyses after every three lab periods. A late penalty of one mark minimum (out of five) will be assessed for each late report.

LABORATORY MARKS:

	Fall	Winter
Practical Test	5.0	-
Experiments	30.0	45.0
Supplementary Calculation Report	5.0	5.0
Laboratory Notebook	5.0	5.0
Total	40.0	55.0

Students who have a score of less than thirty marks for the first term are required to repeat three of the first term experiments before starting the second term experiments. Please see me if you are in this situation. If required you can omit the thorium, fluoride, and the literature problem from the second term work. The reason is that the wet chemical skills are far more important than the use of the instrument.

Students who have a lab score between thirty and forty have the option of repeating three of the first term experiments. Again you must obtain prior approval from me for this. You may not repeat the experiments if the low score is due to calculation errors or late reports.

LABORATORY EXPERIMENTS*

FALL	WINTER
Preliminary Exercises	Literature search problem
Determination of Chloride	Determination of Total salt
Determination of Calcium & Mg	Spectrophotometric Determination of Trace Iron
Titration of an Acid Mixture	Determination of Glucose
Non-aqueous Titration of Benzimidazole	Determination of Benzene by gas chromatography
Iodometric Determination of Copper in Brass	Determination of Nitroaniline Isomers by LC
Determination of Ethylene glycol by periodate cleavage	Determination of Trace Copper by Atomic absorption
	Determination of Fluoride in mouthwash
	Determination of Dextromethorphan in Cough Syrup or Determination of Trace Ni in copper by solvent extraction

*TEXT: *Chemistry 212, Quantitative Analysis*, B. Kratochvil and W. E. Harris, University of Alberta, 1993