



Grande Prairie
Regional College

Science and Technology

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CHEMISTRY 2610 (Fall 2001)

SEP. 10 2002

| | |
|---|---|
| INSTRUCTOR: | Dr. Som K. Pillay (Office: J 210; Tel: 539-2985) |
| PREREQUISITE: | CH1010 and CH1020 |
| TRANSFER CREDITS: | U. of Alberta: CHEM 261, 3 Credits |
| LECTURES: | Mondays & Wednesdays 10:00 - 11:20 A.M. (J 228) |
| SEMINARS: | Fridays (J 201) 8:30 - 9:20 A.M. |
| LABORATORY: | Tuesdays 10:00 - 12:50 P.M. (J 116) |
| TEXT BOOKS AND LABORATORY ITEMS: | L. G. Wade, Jr., <i>Organic Chemistry</i> , 4th Ed., Prentice-Hall, Inc., 1999. L. M. Browne, <i>Experiments in Organic Chemistry, Chemistry 261/263</i> , 2001-2002 Edition, University of Alberta, 2001. Hardcover Laboratory Note Books, Lab Coats and Safety Glasses Molecular Model Set and Chemist's Triangle |
| E-mail: | pillay@gprc.ab.ca or kspillai@telusplanet.net |
| Web Pages: | http://spillay.gprc.ab.ca/ http://pillai.ca/som/ |



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COURSE EVALUATION

THEORY:

| | |
|---|----------------------|
| <i>Assignments/Quizzes:</i> | <i>10.0 %</i> |
| <i>Mid-term Examination (Week of October 22):</i> | <i>27.0 %</i> |
| <i>Final Examination (Week of December 10):</i> | <i><u>38.0 %</u></i> |
| | <i>75.0 %</i> |

Note: *Students must obtain a minimum mark of 50 % in the theory component to pass the course. There will be no supplemental exam or re-examination.*

LABORATORY:

| | |
|--|---------------------|
| <i>General Competence in the Laboratory, Experimental Results, Lab Reports, and Lab Quizzes:</i> | <i>18.0 %</i> |
| <i>Lab Exam:</i> | <i><u>7.0 %</u></i> |
| | <i>25.0 %</i> |

Note: *Students must obtain a minimum mark of 60 % in the laboratory component to pass the course.*

| <i>Grade</i> | <i>Marks (%)</i> | <i>Grade</i> | <i>Marks (%)</i> |
|--------------|------------------|--------------|------------------|
| <i>9</i> | <i>90-100</i> | <i>5</i> | <i>56-65</i> |
| <i>8</i> | <i>80-89</i> | <i>4</i> | <i>50-55</i> |
| <i>7</i> | <i>74-79</i> | <i>3</i> | <i>45-49</i> |
| <i>6</i> | <i>66-73</i> | <i>2</i> | <i>36-44</i> |



COURSE OUTLINE

EMPHASIS IS PLACED ON UNDERSTANDING OF PRINCIPLES AND THE ABILITY TO USE PRINCIPLES TO SOLVE PROBLEMS.

1. STRUCTURE & BONDING (REVIEW)

Approximately two weeks of lectures and two weeks of seminars. The following topics are relevant, and the material should be known from CH 1010 and CH 1020.

Atomic Orbitals; Electron Configuration; Molecular Orbitals & Bonding; Hybrid Orbitals; Delocalized Bonding & Resonance; Molecular Geometry; Electronegativity & Bond Polarity; Intermolecular Forces; Acid-Base Properties; Structural Formulas; Functional Group Classification of Organic Compounds; Nomenclature of Organic Compounds.

Chapters: 1 & 2; Problem Sets: 1 & 2

2. INTRODUCTION TO SPECTROSCOPY

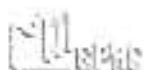
Principles of UV& IR spectroscopy and their Applications to Structural Elucidation of Organic Molecules.

Chapters: 12 & 15; Problem Set: 3

3. INTRODUCTION TO STEREOCHEMISTRY

Nomenclature of Alkanes; Conformations of Cyclic and Acyclic Compounds; Steric Strain; Bicyclic & Polycyclic Compounds; Strained Carbocycles; Geometrical Isomerism; Stereoisomerism; Chirality & Optical Activity; Fisher Projections; Absolute Configuration; The Cahn-Ingold-Prelog System of Nomenclature; Enantiomerism; Racemates; Meso-compounds; Torsional Asymmetry.

Chapters: 3 & 5; Problem Sets: 4 & 5



4. **FREE-RADICAL SUBSTITUTION REACTIONS**

The Reaction Mechanism; Reaction Energetics & Kinetics; Structure & Stability of Free Radicals; Halogenation of Alkanes.

Chapter: 4; Problem Set: 6

5. **NUCLEOPHILIC SUBSTITUTION AND ELIMINATION REACTIONS**

Nomenclature of Alkyl Halides; The S_N1 & S_N2 Mechanisms; Carbocations; The Effect of Substrate Structure; Stereochemistry of Nucleophilic Substitution; The Effect of the Leaving Group; The Effect of the Attacking Nucleophile, The Effect of the Reaction Medium; Rearrangements.

The E1 & E2 Mechanisms; The Effect of Substrate Structure; The Effect of the Leaving Group; Basicity Versus Nucleophilicity; The Effect of the Medium; The Direction of Elimination; Stereochemistry of Elimination; Isotope Effects; Elimination versus Substitution; The Chemistry of Alkyl Halides.

Structure & Nomenclature of Alkenes; Stability of Alkenes; Dehydration of Alcohols; Dehalogenation of Vicinal Dihalides.

Chapters: 6 & 7; Problem Sets: 7, 8 & 9

6. **ELECTROPHILIC ADDITION TO CARBON-CARBON MULTIPLE BONDS**

The Mechanism of Electrophilic Addition; Structure & Reactivity; Orientation and Stereochemistry of Addition; Addition of X_2 , HX , H_2O , HOX , and H_2 ; Hydroboration; Oxymercuration; Alkoxymercuration; Addition of Carbenes; Polymerization; Oxidation Reactions.

Structure & Nomenclature of Alkynes; Acidity of Alkynes; Acetylide Ions as Nucleophiles; Addition Reactions of Alkynes

Structure & Nomenclature of Dienes; Addition to Conjugated Dienes; The Diels-Alder Reaction.

Chapters: 8, 9 & 15; Problem Sets: 10 & 11



7. **ALCOHOLS**

Structure & Nomenclature; Acidity of Alcohols & Phenols; Organometallic Reagents in Alcohol Synthesis; Metal Hydride Reduction of Carbonyl Compounds; Oxidation of Alcohols; Alcohols as Nucleophiles & Electrophiles; The Lucas Test; Dehydration of Alcohols; Pinacol Rearrangement; Periodic Acid Cleavage of Glycols.

Chapters: 10 & 11; Problem Sets: 12 & 13

8. **ETHERS AND EPOXIDES**

Structure & Nomenclature; Synthesis & Reactions of Ethers and Epoxides.
Chapter: 14; Problem Set: 14



LECTURE SESSION

Regular attendance of lectures/seminars 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 classroom. **NO APPOINTMENTS ARE NEEDED.**

TENTATIVE LECTURE SCHEDULE

| WEEK OF | TOPICS |
|---------|--|
| Sept. 3 | Review: Structure and Bonding |
| 10 | Review: Structure and Bonding |
| 17 | Structure and Reactivity |
| 24 | UV & IR Spectroscopy |
| Oct. 1 | Introduction to Stereochemistry |
| 8 | Introduction to Stereochemistry |
| 15 | Free-radical Substitution Reactions |
| 22 | Nucleophilic substitution & Elimination Reactions |
| 29 | Nucleophilic substitution & Elimination Reactions |
| Nov. 5 | Electrophilic Addition to Carbon-Carbon Multiple Bonds |
| 12 | Electrophilic Addition to Carbon-Carbon Multiple Bonds |
| 19 | The Chemistry of Alcohols |
| 26 | The Chemistry of Alcohols |
| Dec. 3 | The Chemistry of Ethers & Epoxides |
| 10 | * FINAL EXAM * |

READING AND PROBLEM ASSIGNMENTS

Problem solving is an essential part of this course. It will guide your study in the right direction and also will help you to monitor your performance in the course.

Approximately 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 8:30 A.M. **NO LATE ASSIGNMENTS ARE ACCEPTED. DON'T ASK!**

| PROBLEM SET # | CHAPTER* | PROBLEMS |
|---------------|----------|--|
| 1 | 1 | 35, 36, 38 - 42, 44 - 47. |
| 2 | 2 | 28, 34, 37-42. |
| 3 | 12 | 16, 20, 23, 25 |
| 3 | 3 | 37, 39, 40, 42 - 44. |
| 4 | 5 | 27, 28, 29, 31, 32, 34 - 36, 38. |
| 5 | 4 | 36, 39, 42 - 44, 46, 49. |
| 6 | 6 | 52 - 55, 59, 61, 67 - 69. |
| 7 | 6 | 70 - 72, 74, 79, 81 - 84. |
| 8 | 7 | 21, 27, 30, 33, 34, 36, 41, 44. |
| 9 | 8 | 44, 46, 53, 55, 56, 58, 60 - 62, 64, 65, 67, 69. |
| 10 | 9 | 29, 33 - 37, 39, 40. |
| | 15 | 25, 27, 30, 33, 34. |
| 11 | 10 | 31, 32, 35, 37, 38, 40, 42, 44, 45, 46, 48. |
| 12 | 11 | 40, 41, 46, 48 - 53, 55, 58. |
| 13 | 14 | 30, 31, 35 - 37, 39, 42, 43. |

*TEXT: L. G. Wade, Jr., *Organic Chemistry*, 4th Ed., Prentice-Hall, Inc., 1999.



LABORATORY SESSION

Laboratory sessions start at 10:00 A.M. sharp. Surprise Lab Quizzes will be administered at the beginning of the laboratory period. All students are expected to come to the laboratory well prepared in the experiment that is to be performed and on time.

Students are expected to attend all laboratory periods. Absences due to illness must be substantiated by presenting suitable evidence to the Instructor/Laboratory Technologist within one week of missing the lab. An opportunity to make-up a lab will be given only for **excused absences**.

The laboratory experiments are designed to allow a well-prepared student to finish all the work within the allotted time. If necessary, melting points and weights of dry samples may be measured between 8:30 and 11:20 hours on Thursdays. You may complete any other unfinished part of the experiment during the regular laboratory period the following week. **IT IS YOUR RESPONSIBILITY TO COMPLETE THE LAB ON TIME.**

Students are responsible for keeping the lab tidy. Failure to keep the workbench and common areas tidy will result in **demerits of up to 5 marks** each lab period.

LABORATORY REPORT:

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

Formal lab reports should be written using the format given in your laboratory manual. The lab report should be handed in with your samples at the beginning of the next laboratory period. **NO LATE LAB REPORTS ARE ACCEPTED.**

TENTATIVE LABORATORY SCHEDULE

| DATE | EXPERIMENT* |
|----------|--|
| Sept. 11 | 1. Check In: Lab and Safety Orientation |
| 18 | 2. Solids: Purity and Identification |
| 25 | 3. Solids: Purity and Identification |
| Oct. 2 | 4. Infrared Spectroscopy |
| 16 | 5. Liquids: Purity and Identification |
| 23 | 6. Trimyristin from Nutmeg |
| 30 | 7. Separation Based on Solubility |
| Nov. 6 | 8. Separation Based on Solubility |
| 13 | 8. Bromination of Cholesterol |
| 20 | 9. The Diels-Alder Reaction |
| 27 | 10. Lab Exam |
| Dec. 4 | * Check Out * |

*TEXT: L. M. Browne, *Experiments in Organic Chemistry, Chemistry 261/263*, 2000-2001 Edition, University of Alberta, 2001.

ONLINE RESOURCES

Lecture Topics:

<http://spillay.gprc.ab.ca/>

<http://pillai.ca/som/>

<http://cw.prenhall.com/bookbind/pubbooks/wade/>

<http://www.chem.ualberta.ca/~bundle/index.html>

<http://www.chemistry.ohio-state.edu/organic/flashcards/>

<http://saber.towson.edu/~sweeting/orgrxs/reactsum.htm>

<http://www.brunel.ac.uk/depts/chem/project/tutorial/mech/mech.htm>

<http://www.brunel.ac.uk/depts/chem/definit/definit.htm>

Labs:

<http://www.chem.ualberta.ca/~orglabs/161-261/261home.html>

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