Chemistry 315 **Fall 2012**

SYNTHETIC ORGANIC CHEMISTRY

R.D. Libby
213 Collier
Ext. 1436

Class Hours
TR 10:20-11:30 AM

Office Hours
Mon 10:00 ->11:00AM
Wed 10:00 ->11:00AM
Thurs 9:00 ->10:00AM
Fri 10:00 ->11:00AM
Or any time, just call X1436

TEXT: *Organic Synthesis: The Disconnection Approach*,
by Stuart Warren & Paul Wyatt (WW), 2nd

REFERENCE: Organic Class Notes and Any Introductory Organic Text.

COURSE OUTLINE:

I. Introduction:
   A. Disconnection Approach to Organic Synthesis. WW Ch 1
   B. Basic Principles: Synthons and Reagents - Synthesis of Aromatic Compounds WW Ch 2

II. Specific Strategies:

A.	Strategy I: Order of Events	WW Ch 3
B.	One Group C-X Disconnections	WW Ch 4
C.	Strategy II: Cemoselectivity	WW Ch 5
D.	Two Group C-X Disconnections	WW Ch 6
D.	Strategy III: Reversal of Polarity & Cyclization	WW Ch 7
E.	Amine Synthesis	WW Ch 8
F.	Strategy IV: Protecting Groups	WW Ch 9
G.	One Group C-C Disconnections I: Alcohols	WW Ch 10
H.	General Strategy A: Choosing a Disconnection	WW Ch 11
I.	Strategy V: Stereoselectivity A	WW Ch 12
J.	One Group C-C Disconnections II: Carbonyl Compounds	WW Ch 13
K.	Strategy VI: Regioselectivity	WW Ch 14
L.	Alkene Synthesis	WW Ch 15
M.	Strategy VII: Use of Acetylenes (Alkynes)	WW Ch 16
N.	Two Group C-C Disconnections I: Diels-Alder Reactions	WW Ch 17
O.	Strategy VIII: Introduction to Carbonyl Condensations	WW Ch 18
P.	Two Group C-C Disconnections II: 1,3-Difunctional Cpds	WW Ch 19
Q	Strategy IX: Control in Carbonyl Condensations	WW Ch 20
R	Two Group C-C Disconnections III: 1,2-Difunctional Cpds Michael Additions and Robinson Annelations	WW Ch 21
S.	Strategy X: Aliphatic Nitro Compounds in Synthesis	WW Ch 22
T.	Two Group C-C Disconnections IV: 1,2-Difunctional Cpds	WW Ch 23
U.	Strategy XI: Radical Reactions in Synthesis	WW Ch 24
V.	Two Group C-C Disconnections V: 1,4-Difunctional Cpds	WW Ch 25
W.	Strategy XII: Reconnection	WW Ch 26
X.	Two Group C-C Disconnections VI: 1,6-Difunctional Cpds	WW Ch 27
W.	General Strategies B: Carbonyl Disconnections	WW Ch 28
X.	Strategy XIII: Introduction to Ring Synthesis: Saturated Heterocycles	WW Ch 29
Y.	Three-Membered Rings	WW Ch 30
Z.	Strategy XIV: Rearrangements in Synthesis	WW Ch 31
Z2.	Four-Membered Rings: Photochemistry in Synthesis	WW Ch 32

CLASS GOALS AND FORMAT

This course will be run in a group discussion manner. The value of class periods is largely dependent upon what each student contributes. Each new topic or concept will be presented to you as an activity, which may include data to analyze, information to recall or look up, and some questions to guide your work. You will be required to work as a group, both inside and outside of class, to devise what you believe to be reasonable responses, interpretations or other analyses. Each day I will solicit your responses to each part of the day's activity. We will then discuss these initial analyses or interpretations and try to identify the strong and weak points of the proposals. Ultimately we will agree on approaches that provide us new insights into the logic and process of designing and carrying out efficient syntheses of organic molecules. Our initial conclusions will then be tested through their application to additional syntheses. Applications will sometimes be done as a group in class, and other times will be out of class work assignments. As the semester progresses, you should begin to develop a personal "sense" of synthetic organic chemistry that will aid you in each subsequent activity. I believe that you will find the group discussions very useful in your learning process. In general, **this class is designed to simulate the way many scientists actually work to design new synthetic processes; it is usually a group effort.** The course structure encourages you to **take responsibility for and an active part in your education** in the area of synthetic organic chemistry. Educational research indicates that students who are actively involved with peers as they work on class material, as you will be, tend to learn more in their courses and retain more in the future. I hope that you will find that working with your classmates will help in generating new ideas and provide you better insight in your analyses of the daily activities. We will have a class website (http://www.chem.moravian.edu/~rdlibby/chem315-12.html) to aid you in your out of class work, and much of the course material will be posted there.

ADMINISTRATIVE POLICIES

Missed Exam or Quizzes:

Students are required to take all exams and quizzes. There will be ***NO MAKE-UPS***. If an exam or quiz is missed without a valid medical excuse (verified by the Health Center) or other accepted ***prior*** excuse, the grade for that work will be zero. The grade for an exam or quiz missed due to an excused absence will be determined from the grades earned on the remaining work for the semester, i.e. more value will be added to subsequent exam, quizzes, Library Projects or Final Project.

NOTE: Travel schedules for weekends or breaks are not acceptable excuses for missing quizzes or exam.

Collaboration and Academic Honesty

Collaboration among students in class and in preparation for class discussion is generally encouraged and required for most classes. However, the final version of all written work submitted for evaluation must be prepared without consultation with other students. To be fair to all students in the course and to assure maximum learning for each student, we follow all the guidelines for academic honesty spelled out in the *Moravian College Student Handbook* (See College Website http://www.moravian.edu/studentLife/handbook/academic/academic2.html)

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DISABILITY SUPPORT

Students who wish to request accommodations in this class for a disability should contact Ms. Elaine Mara, Assistant Director of Learning Services for Disability Support, 1307 Main Street (extension 1510). Accommodations cannot be provided until authorization is received from the office of Learning Services.

EVALUATION

Quizzes	15 %
Mid-term Take-Home Exam	20 %
Library Projects	20 %
Group Work	20 %
Final Synthetic Proposal	25 %

Quizzes:
There will be short individual in-class quizzes each week. The quizzes are designed to provide some encouragement for everyone to get involved in the class activities and stay up with the development of new synthetic methods throughout the semester.

Mid-term Take-Home Exam:

There will be a single Mid-term exam. It will be a take-home exam to be given out on Tuesday October 16 with your answers to be due by 5:00 PM on Tuesday, October 23. You may **work alone or with your classmates to devise answers to the questions**. However, you must write the **final copy of your exam without direct consultation with others on the wording, specific procedures or equations** (NO CARBON COPIES). In short your submitted answers are to be your own understanding of the material in your own words based on work in class and discussions with classmates.

Library Projects:

There will be two opportunities for you to select and analyze original articles on synthetic organic chemistry. The specifics of these two projects are provided on page 6.

Group Work
As explained in the group description and duty assignments given below, at the end of each class, the group managers and reporters will submit reports on the groups' activities and questions for the day. The reports include group responses to specific questions on the day's activity sheet and one or more specific comments or questions the group has about the activity and/or class conclusions from the material being considered. Daily group reports and contributions to class discussion will determine each student's "group work" grade. This grade is designed to recognize and reward individual contributions to group discussions.

Final Project

A Proposal for the Synthesis of an Interesting Organic Molecule

The final requirement for this course is to submit an original proposal for research on an appropriate synthetic problem. The specifics of this requirement are provided on p. 5.

CLASS GROUPS

***Group Composition and Dynamics*:** In class, each day each member of the group has a specific role to play in making your collective learning experiences profitable. The duties associated with the specific roles are described below. **Every day every member of the group will be assigned a new role**.

***Group Role Definitions*:**

Manager

Manages the group. Insures that the group has the **appropriate materials** (class and lab textbooks, molecular models, etc.), **members are fulfilling their roles**, the **assigned tasks are being accomplished on time**, and **all members** of the group **work through activities step-by-step together** and **understand the concepts**. The Manager **communicates with the instructor** when information or assistance is required and is responsible for seeing that group recorder's report **is submitted in a timely manner**.

Recorder

Obtains the **group tablet laptop, downloads the electronic activity from the server, renames the activity with the group name** and **records group answers and explanations** of the group's conclusions for each question in the electronic class activity for the day. Is **responsible for determining that all group members understand** and **agree on the group's response** to an activity question **before moving on** to the next question. At the end of each class period, **copies the group Electronic Recorder's Report to the network server** and returns **the group tablet laptop** to the cart **assuring that it is plugged in for charging**. The Electronic Recorder's Report will be considered to be the official group response to each day's activities.

Strategy Analyst

At the direction of the manager, **reads each activity question to the group** to help the group stay together. As the activity develops, **focuses on how the sequence of questions leads** the group **to develop particular concepts**. At the end of each activity, leads the Strategy Analyst's Report Discussion of the logic behind the sequence of questions of the activity and assures that the sense of the group is documented by the recorder.

Presenter

When necessary, obtains the group folder at the beginning of class. **Explains group conclusions** to the class when requested by the instructor; these explanations will usually be presented in conjunction with the recorder's report projected on the screen in front of the class, and will be the bases for whole class discussions. **Shares information with other groups** when indicated by the manager or instructor. **Returns the group folder** to the instructor at the end of class.

Reflector

Observes and comments to the manager **on group dynamics and behavior** with respect to the learning process, and **the effectiveness of the group** in dealing with daily assignments. May be called upon to report to the group, the instructor, or the entire class concerning how well the group is operating or what needs improvement and why. Assures that all **group members recognize the concepts developed** in each activity. At the end of each activity, leads the Reflector's Report Discussion identifying the group's consensus on the key concepts developed by the group and identifying the group's remaining questions.

NOTE: In groups of **four people**, one student will fill both the **Presenter and Reflector** roles. In groups of **three people**, the **Manager** will also fill the **Strategy Analyst** role.

FALL 2012
CHEM 315 SYNTHETIC ORGANIC CHEMISTRY
Library Project 1

This project is designed to give you some experience with reading, interpreting and writing about original research in synthetic organic chemistry.

A. The requirements for this project are:
   1. Choose an article on organic synthesis from a recent issue (last two or three years) of a chemical journal. The article must be an original research report (not a review article). The article may deal with the synthesis of a specific molecule or class of molecules, or with the development of new synthetic methods, but the main focus of the work must be synthesis rather than theory or reaction mechanisms.
   2. Write a 4-5 page paper explaining your understanding of the article. Be sure to deal with the following points:
      a. The primary goal of the work.
      b. The reasons the authors gave for doing this work.
      c. Who funded the research?
      d. The major experimental techniques used in the study.
      f. Ways in which this work conforms or does not conform to methods discussed in class.
      e. Your evaluation of the quality of the work and what new insights it provided you into the process of organic synthesis.

B. Schedule for completion:
   1. On or before Tuesday, September 18, submit a photocopy of your chosen article.
   2. Your paper is due by 5:00 PM on Thursday, October 4.

Library Project 2

This project is designed to give you a second experience with reading and interpreting original research reports that deal with organic synthesis, and with making an oral presentation of a scientific study.

A. The requirements for this project are:
   1. Choose another article on organic synthesis from a recent issue (last two or three years) of a chemical journal. Again, the article must be an original research report (not a review article). The article may deal with the synthesis of a specific molecule or class of molecules or with development of new synthetic methods, but the main focus of the work must be synthesis rather than theory or reaction mechanisms. This must be a different article from the one you used for Library Project 1, but the work reported may be related to the first article.
   2. Prepare and give a 10 min. oral presentation that gives an overview of the study described in your article and an explanation of the goals and reasons for doing the work, as well as its primary contributions to the synthetic organic literature.
   3. Submit a one page written abstract of your presentation.
   4. Read the articles chosen by other class members and be prepared to comment on their presentations and ask them questions. (Part of your grade).

B. Schedule for completion:
   1. On or before Tuesday, November 20, submit a photocopy of your chosen article and choose a date, during the week of December 3, for your presentation. I will make copies of articles and distribute them to other members of the class on Tuesday, November 27.
   2. During the week of December 3, make your presentation.
   3. On or before Friday, December 7 (last day of class), submit your abstract.

CHEM 315 SYNTHETIC ORGANIC CHEMISTRY

Final Project

A Proposal for the Synthesis of an Interesting Organic Molecule

Introduction

There is no final exam in CHEM 315. Instead your final assignment for the course is to prepare a proposal on a synthetic problem of your choosing. Your choice may be related to experience with your Library Projects, class work, the text, or compounds that have interested you in the past. Your synthesis may be the first attempt at the synthesis of a molecule, or a new approach for an improved synthesis of a molecule that has been synthesized previously. The textbook, *Organic Synthesis* by Michael Smith, available on the CHEM 315 shelf in 221 Collier provides some examples (Chapter 14) of student synthetic proposals.

Format

Your proposal will be written in the form required by the Petroleum Research Fund (PRF) of the American Chemical Society Undergraduate New Investigator (UNI) program. The Petroleum Research Fund is a funding agency that supports basic research in organic chemistry and related areas. Information an application forms can be found by search PRF UNI in Google. The PRF website will guide you in the format, background information, and materials required.

Schedule

1. Thursday, October 25: Choose a synthetic problem and submit a description (no more than one page) of the proposed problem.
2. Thursday, November 8: Submit the results of a SciFinder literature search related to your problem. This should be an annotated bibliography briefly explaining how each reference relates to your project.
3. Tuesday, November 20: Submit a one or two page summary of your synthetic route.
4. Friday, December 14: Final proposals are due by 5:00 PM. (Date of the Final Exam)

Synthetic Organic Reference List

This is a partial list of organic synthesis references available in Reeves Library

PRINTED MATL 2008
Six-membered transition states in organic synthesis / Jaemoon Yang
Yang, Jaemoon.
IN - Moravian Book Stacks - QD502.5 .Y36 2008 -

PRINTED MATL 2008
Nitrile oxides, nitrones, and nitronates in organic synthesis [electronic resource]: novel strategies in synthesis / edited by Henry Feuer
Moravian eBooks
IN - Moravian Electronic Books - -

EBOOKS 2001
Organic synthesis engineering [electronic resource] / L.K. Doraiswamy
Doraiswamy, L. K. (Laxmangudi Krishnamurthy)
Moravian eBooks
IN - Moravian Electronic Books - -

PRINTED MATL 1994
Organic synthesis: concepts, methods, starting materials / Jurgen Fuhrhop, Gustav Penzlin
Fuhrhop, Jurgen-Hinrich.
IN - Moravian Book Stacks - QD262 .F78 1994 -

PRINTED MATL 1979
Carbanions in organic synthesis / John C. Stowell
Stowell, John Charles, 1938-
IN - Moravian Book Stacks - QD305.C3 S76 -

PRINTED MATL 1979
Concepts of organic synthesis: carbocyclic chemistry / Bradford P. Mundy
Mundy, Bradford P., 1938-
IN - Moravian Book Stacks - QD262 .M79 -

PRINTED MATL 1969
Organic synthesis / [by] Robert E. Ireland
Ireland, Robert E., 1929-
IN - Moravian Book Stacks - QD262 .I7 -

PRINTED MATL 1968
Reduction; techniques and applications in organic synthesis / edited by Robert L. Augustine
Augustine, Robert L., 1932-
IN - Moravian Book Stacks - QD281.R4 A93 -

PRINT ED
MATL 1967 -

Reagents for organic synthesis / [by] Louis F. Fieser [and] Mary Fieser
Fieser, Louis Frederick, 1899-
IN - Moravian Book Stacks - QD262 .F5 V.10 -
Show all 8 available copies/volumes

PRINT ED
MATL 1965

Catalytic hydrogenation; techniques and applications in organic synthesis / [by] Robert L. Augustine
Augustine, Robert L., 1932-
IN - Moravian Book Stacks - QD281.H8 A9 -

PRINT ED
MATL 2008

The organic chemistry of drug synthesis. Volume 7 / [electronic resource] / Daniel Lednicer
Moravian eBooks
IN - Moravian Electronic Books - -

PRINT ED
MATL 2008

Molecules that changed the world: a brief history of the art and science of synthesis and its impact on society / K.C. Nicolaou, T. Montagnon; with forewords by Nobel laureates, E.J. Corey, R. Noyori
Nicolaou, K. C.
IN - Moravian Book Stacks - QD262 .N53 2008 -

Journals with Significant Synthetic Material (in Reeves)

Angewandt Chemie International Edition
Journal of the American Chemical Society
Journal of Organic Chemistry

In Lehigh Chemistry Library (Fairchild)

Tetrahedron
Tetrahedron Letters