Chemistry 642

Organic Synthetic Methods

Fall, 2015

Dr. Ben Gung, 260B Hughes (gungbw@muohio.edu, Phone 529-2825)

Office Hours: by appointment.

Lectures: 10:00-10:55 am., Room 158 Hughes

Text: "Modern Organic Synthesis: An Introduction" by George Zweifel and Michael Nantz

Clicker: You must have a Turning Point Response Card or smart phone with Response software for interactive learning during lectures. Attendance is automatically recorded by Turning Point software and is rewarded with points. Instructions on how to register your clicker and/or response software will be presented in lecture

Course Outline

1. The fundamentals (Chapter 2 and Website)

A. Proper representations of valence bond structures (Lewis, line-bond structures)

B. Conformational analysis (ethane, butane, and cyclohexanes)

C. Stereochemistry (tetrahedral sp3 carbon, *Z*- and *E*-double bond geometry; chirality, *R* and *S* configuration, *P*- and *M*-configuration for substituted allenes)

2. Functional group transformation (Chapters 3-5 and Website)

A. Alkene reactions

B. Carbonyl reactions

C. Oxidation (CrO_3, Jones, PCC, Swern, Dess-Martin, $NaClO_2$, O_3 etc.) Reduction (Hydride reducing reagents: $NaBH_4$, $LiAlH_4$, DIBAL-H, BH_3, Red Al and hydrogenation, dissolving metal reduction, etc.)

D. Protecting groups in synthesis (protection of -OH, -NH_2, C=O, etc. Chapter 3)

3. Enolate related reactions (Chapter 6)

A. Aldol condensation reaction

B. Claisen and Dieckmann condensaion reactions

C. Michael addition and Robinson annulation

D. Alkylation reaction

4. Preparation of C-C single bonds (Chapter 7)

A. Grignard reagents (acidities of organic compounds, pKs's)

B. Organolithium reagents

C. Organocopper reagents

D. Cross coupling reactions (Sonogashira, Suzuki, and Stille couplings)

5. Preparation of C=C double bonds (Chapter 8)

A. Dehydration reactions

B. Reduction of alkynes

C. Wittig and Horner-Wadsworth-Emmons Reactions

D. Olefin metathesis (Grubbs catalysts)

E. Claisen Rearrangement

6. Synthesis of carbocycles and heterocycles (Chapter 9)

A. Acyloin Condensation and Pinacol coupling

B. Cation-pi cyclization

C. Diels-Alder Reactions

D. Ring Closing Metathesis

7. Asymmetric synthesis (selective topics from Chapters 2-9)

A. Carbonyl additions: Felkin-Anh and Cornforth models (gen 1, substrate control)

B. Chiral auxiliaries (Second generation, substrate control)

C. Epoxidations (Sharpless, Jacobson), dihydroxylation (Sharpless), hydroborations (Brown) (Third generation, reagent control).

D. Asymmetric Catalysis (Fourth generation).

Grading. Grades in this course will be derived from a combination of homework assignments, in class quizzes, and take-home midterm and final exams. Grades awarded to answers written in pencil will not be changed after tests or assignments have been returned.

Quizzes (7):	210 (35 pts each, top 6 scores will be recorded)
Attendance:	25
Midterm:	100
Final:	100
Course Total:	435

Approximate cutoffs: A ≥ 90%, B ≥ 75%, C ≥ 60%, D ≥ 50%, F < 50%. Plus/minus grades will generally not be awarded. The grading scale may be adjusted downward at the discretion of the instructor.

General References:

(1) Carey, F.A. and Sundberg, R. J., "Advanced Organic Chemistry" Part B: Reactions and Synthesis" Fourth Edition, Plenum Press, 2001.

(2) Richard C. Larock, "*Comprehensive Organic Transformations*", 2nd edition.

(3) Greene, T. W. and Wuts, P. G. M. "Protective Groups in Organic Synthesis", Third Edition.

(4) Kocienski, P. J., "Protecting Groups", Theime Verlag: Stuttgart, 1994.

Tentative Schedule

Week	Date	Subject	Chapters
1	08/24-28	Organic compound structures	Review of O-Chem.
		Stereoisomers	Zweifel Ch. 2
2-4	09/2-18	Functional group transformation	Zweifel Ch. 3, 4, 5
		Quiz 1, 09/04	
		C=C and C=O chemistry	
		Oxidation and reduction	
		Quiz 2, 09/18	
5-6	09/21-09/25	C-C bond formation, enolate chemistry	Zweifel Ch. 6
7-8	09/28-10/07	Organometallic reagents	Zweifel Ch. 7
		Quiz 3, 10/02	
	10/09	**Midterm exam** (due 10/12 by 5 pm)	Ch. 2-7
		Quiz 4, 10/16	
9-11	10/19-11/06	Claisen rearrangement and Cycloadditions	Zweifel Ch. 8, 9
		Ring Closing Metathesis	
		Quiz 5, 10/30	
12-14	11/09-12/02	Stereochemistry and Chirality	Revisit Ch. 2-9
		Asymmetric Synthesis	
		Quiz 6, 11/13	
		Quiz 7, 12/04	
15	12/04	**Final exam** available (due 12/09 by 5:00 pm)	All chapters

◄ Jul 2015

~ August 2015 ~

Sep 2015 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23 Week 1	24 Class starts	25	26	27	28	29
30 Week 2	31	**Notes:**				

◄ Aug 2015

~ September 2015 ~

Oct 2015 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
Week 2		**1**	**2**	**3**	**4** Quiz 1	**5**
6 Week 3	**7**	**8**	**9**	**10**	**11**	**12**
13 Week 4	**14**	**15**	**16**	**17**	**18** Quiz 2	**19**
20 Week 5	**21**	**22**	**23**	**24**	**25**	**26**
27 Week 6	**28**	**29**	**30**	**Notes:**		

◄ Sep 2015

~ October 2015 ~

Nov 2015 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
Week 6				**1**	**2** Quiz 3	**3**
4 Week 7	**5**	**6**	**7**	**8**	**9** Midterm Break: Email Midterm exam	**10**
11 Week 8	**12** Midterm Exam due by 5 pm	**13**	**14**	**15**	**16**	**17**
18 Week 9	**19**	**20**	**21**	**22**	**23** Quiz 4	**24**
25 Week 10	**26**	**27**	**28**	**29**	**30**	**31**

◄ Oct 2015

~ November 2015 ~

Dec 2015 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1 Week 11	**2**	**3**	**4**	**5**	**6** Quiz 5	**7**
8 Week 12	**9**	**10**	**11**	**12**	**13**	**14**
15 Week 13	**16**	**17**	**18**	**19**	**20** Quiz 6	**21**
22 Week 14	**23**	**24**	**25** Thanksgiving No class	**26** Thanksgiving No class	**27** Thanksgiving No class	**28**
29 Week 15	**30**	**Notes:**				

◄ Nov 2015

~ December 2015 ~

Jan 2016 ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
Week 15		**1**	**2**	**3**	**4** Quiz 7 Get your Final exam	**5**
6 Week 16 Final exam week	**7**	**8**	**9** Final exam due by 5 pm	**10**	**11**	**12**
13	**14**	**15**	**16**	**17**	**18**	**19**
20	**21**	**22**	**23**	**24**	**25**	**26**
27	**28**	**29**	**30**	**31**	**Notes:**	