

KJE3301 Organic Chemistry II - Syllabus 2017

Literature:

Main book

Okuyama, T.; Maskill, H. *"Organic Chemistry - a mechanistic approach"*, Oxford University Press 2014.

Supplementary materials:

Hand-out notes, multistep syntheses from current literature

Molecular model set.

Many useful summaries at www.masterorganicchemistry.com

Pedagogical learning strategies and activities:

Cooperative learning groups (study groups):

Study group of maximum 4 students is formed the first week. Find time and place for weekly meetings of about 1-2 hrs. This strategy addresses team work skills. Moreover, explaining ideas to others is incredibly effective for increasing ones own understanding. *Group activities:* Every week, the group solves a problem set outside of classroom time. The problem sets will consist of various problems requiring higher-order thinking and team-work to solve. The logic behind the answer is just as important as the answer itself. The work will be submitted the following week and graded. The whole group receives the same grade. The problem sets will be subject to classroom discussions.

Pre-class preparation:

Read assigned chapters before first lecture on Mondays(!). One-minute blue book quizzes every Monday morning (if you read the assignment, the quiz is easy). In-text exercises: Do all in-text exercises in the journal as you read for monitoring your own understanding. The online book quizzes for each chapter are also very useful for this purpose and are strongly recommended.

Individual activities and exam questions:

The individual activities will be documented in the blue book journal provided by instructor at the beginning of the course.

- Reading:* Read assigned material from the book according to this course plan.
- Bluebook problem sets:* Do the Bluebook problem sets (Fronter) individually in your Blue journal. Do not erase wrong answers, just cross them out so that I can analyze typical problems that students have with the material for further clarification in class.
- Reading memos:* make notes of problems with the reading material that hampers understanding.
- Create an exam problem with an answer key for each chapter.* Pay attention to the difficulty level (not too easy, not too hard), and be ready to present your problem in class.
- The answers to in-class Monday quizzes* must be documented in journal.

Exams

The course ends with a written 5h final exam with questions from lab and lecture materials. At least one variant of your suggested exam questions will be there.

Labs

Laboratory part of the course will run intensively in late October. Theoretical prep beforehand will be checked with laboratory quizzes. Moreover, students must explain mechanisms during lab session while reactions run.

Course Plan 2017

READING	SESSION EMPHASIS OR EXTRAS	GROUP EXERCISES	BLUEBOOK EXERCISES (INDIVIDUAL)
WEEK0			
<i>Chapters 1-5</i> must be learned by self-study.	Read through and do online quizzes on book homepage. Print out the chapter quizzes and hand them in, then study more closely the areas that are problematic and repeat the quizzes to check that you have understood.		
<i>Introductory lecture</i>	Introduction to importance of organic chemistry. Resources available (book, Fronter, book homepage etc). Consent form		
WEEK1 28. aug-1.sept			
<i>Chapter 5: Conjugation, delocalization and aromaticity</i> (supplement)	Qualitative frontier molecular orbital model and reactivity Orbital energetics	Ex1: Acid-catalyzed mechanisms	Ex1: Structure, mechanism, aromaticity
<i>Chapter 6: Acids and bases</i>	Nucleophile vs base fundamentals of pKa		
<i>Chapter 7: Organic reaction and the mechanism concept</i>	Curly arrow notation - explicit! MO-description of reactivity Energetics, equilibrium and kinetic factors to consider in mechanisms. Introduction to catalysis principles and acid catalysis in organic chemistry		
WEEK2 3. sept-8. sept.			
<i>Chapter 8: Nucleophilic carbonyl addition in ketones and aldehydes</i>	Nucleophile vs base discussion Ketal mechanisms with focus on arrow push Wittig reaction	Ex2: Nucleophilic carbonyl additions	Ex2: Nucleophilic carbonyl additions

<i>Chapter 9: Nucleophilic substitutions of carboxylic acid derivatives</i>	In-depth on reactivity differences Infrared spectroscopy and CO trends		
<i>Chapter 10: Reactions of Carbonyl Compounds with Hydride Donors and Organometallic Reagents</i>	Characteristics of important reductants and reactivity		
WEEK3 11. sept. - 15. sept.			
<i>Chapter 11: Stereochemistry and molecular chirality</i>	Brief repetition of basics Focus on chirality transfer and origins of asymmetric induction in reactions Prochirality	Ex3: Chiral catalysis	Ex3 Stereochemistry
<i>Hand-outs on catalysis and lecture notes on chirality transfer/chiral catalysis</i>	Chiral catalysis or chiral auxiliary examples Asymmetric organocatalysis		
WEEK4 18. sept - 22. sept.			
<i>Chapter 12: Nucleophilic substitution reactions of haloalkanes and related compounds</i>	Nucleophile vs base Solvent effects (Hughes-Ingold model) MO descriptions Moore O'Ferral Jencks diagrams		
<i>Chapter 13: Elimination reactions of haloalkanes and related compounds</i>			
<i>Chapter 14: Reactions of alcohols, ethers, thiols, sulfides and amines</i>			
WEEK5 25. sept - 29. sept.			
<i>Chapter 15: Addition reactions of alkenes and alkynes</i>	Cyclopropanation with metal carbenes		

	Thermodynamic and kinetic principles		
<i>Chapter 16: Electrophilic aromatic substitution</i>			
WEEK6 2.oct. - 6.oct.			
<i>Chapter 17: Enolate ion, their equivalent and reactions</i>	Enamine catalysis Thermodynamic vs kinetic control		
<i>Chapter 18: Reactions of nucleophiles with alkene and aromatic compounds</i>			
WEEK7 9. oct - 13. oct			
<i>Chapter 19: Polycyclic and Heterocyclic aromatic compounds</i>	Class handouts on heterocycle formation		
WEEK 8-10 16. oct - 3. nov.	LABORATORY	LABORATORY	LABORATORY
PRELAB1 Laboratory safety and risk assessment			
PRELAB 2 Purification and characterization	Crystallization Gradient flash chromatography Characterization flow chart	NMR (carbon and proton) LR/HR-MS IR GC	
PRELAB 3 Reporting and format	Templates and content Data reporting standards		
LAB1 Claisen-Schmidt condensation	GC-purity analysis	Report 1	
LAB2 Substitution-Wittig olefination		Report 2	
LAB3 Pyrazolination		Report 3	
LAB4 Oxidative aromatization		Report 4	

LAB5 Individual project		Report 5	
WEEK11 6. nov - 10. nov			
<i>Chapter 20: Reactions involving radicals</i>	Photocatalysis mechanistic aspects and principles		
WEEK12 13. nov - 17. nov			
<i>Chapter 21: Pericyclic reactions: cycloadditions, electrocyclic reactions and sigmatropic rearrangements</i>	MO description Stereochemistry Chiral catalysis		
WEEK13 20. nov - 24. nov			
<i>Chapter 22: Rearrangement reactions involving polar molecules and ions</i>			
WEEK14 27. nov - 1. dec.			
<i>Chapter 23: Organic synthesis</i>	Multistep organic synthesis Retrosynthetic analysis Atom economy Review sessions		
FINAL EXAM	5h written exam to be announced!		