Dear Students,

I have compiled a list of relevant chapters and sections from your Solomons & Fryhle textbook (9th edition). If I wrote “Chapter 1.1”, please assume that I suggest reading all of Chapter 1.1. If I felt otherwise, the key sections will be specified explicitly. I have also suggested review problems up to chapter 5. Your teaching assistants will assign the remaining questions. Your TAs will also coordinate the recitation material week by week (Dear Ayda and Mert – please cc the question numbers to me every time you assign some).

All the best, AT

Refer to chapter 1 (all sections) Note: Refer ≠ Read!
Do review problems 1.1-1.15; exercises 1.16-1.23; and problems 1.24, 1.25

Refer to chapter 2.1-2.13; (2.14 & 2.15 optional); 2.16
Do review problems 2.1-2.16 & 2.19; exercises 2.20a,c,f; 2.21a,b,c,e; 2.22, 2.24-2.26; and problems 2.27a,c,e, 2.28a,b

Refer to chapter 3.1-3.4; (3.5 optional); 3.6intro; 3.7; 3.8intro; 3.10; 3.12; 3.13
Do review problems 3.1, 3.2, 3.8; 3.11a,c,d; 3.13b; exercises 3.15a,c,e; 3.19b; 3.20; and problems 3.25a; 3.30

Refer to chapter 4.2; 4.3; 4.4 (4.4B optional); 4.5; 4.6; (4.7 optional); 4.8-4.14; (section 4.15 optional); 4.16; 4.17
Do review problems 4.1-4.6; 4.8a,c; 4.9a,b,i; 4.11; 4.13; 4.14; 4.16try it; exercises 4.22a-h,l; 4.23a-d; 4.24; 4.28; and problems 4.29; 4.31; 4.39b,d,e; 4.45; 4.47c

Refer to chapter 5 (sections 5.17 & 5.18 are optional)
Do review problems 5.1-5.29; exercises 5.30a-d; 5.33; 5.35; and problem 5.39


Grading ☺/70% Class performance: Two midterm exams (2 x 15%), one final exam (30%), one organic chemistry problems assignment (10%), and one Internet search assignment (submission is required to pass this course).

- The midterm exams: 1st is 2h (on 6 November); 2nd is 2h (on 25 December – covers everything)
- The final exam is 3h (on 22 January, unless there is a time conflict)
- The problems assignment will be issued on 30 October. Assignments are due on 8 January (-10% per weekday late, weekends and holidays exempt). If you answer the questions above, the assignment should be easy.
- The Internet search assignment will be issued on 11 December and will be due on 3 January. Successful submission is required to complete this course (yani, you must complete this assignment properly to receive a non-I or non-F grade; -1 letter grade per weekday late, weekends and holidays exempt). Assignment instructions: You will be issued a list of citations. You will find the corresponding scientific articles online. You must identify each pdf using to the article’s full title and you must submit a presentable (i.e., nicely labeled) CD to your TA. If you have problems finding any articles, please do not ask your over-worked TAs for help. Rather, please ask the experts at the Information Center.
30% Laboratory performance: To perform well in the laboratory, you must document your work and upkeep a very good laboratory book. Why? Your lab book is your record, your evidence, your whole scientific world and future!!! Why do we only use pen to write? Why do you draw a line through a mistake, rather than erase or whiteout the writing? (Hint – industry, patents, evidence). Your TAs will evaluate your laboratory performance and lab write-ups. They will set all deadlines related to the lab sessions. An additional 3% bonus may be awarded by the TA for good participation in the tutorial sessions (yani, LP = 0-to-30% + 0-to-3% bonus).

<table>
<thead>
<tr>
<th>Concepts</th>
<th>Tentative Overview of Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scope and history of organic chemistry – Differences between organic and inorganic compounds, vitalistic theory, quantitative determination of carbon, hydrogen and nitrogen in organic substances by combustion analysis, pioneers and Nobel Laureates related to biological organic chemistry</td>
</tr>
<tr>
<td>2</td>
<td>Structure and bonding of organic molecules - Covalent versus ionic bonds, octet condition, molecular overlap, sp&lt;sup&gt;2&lt;/sup&gt;, sp&lt;sup&gt;3&lt;/sup&gt; and sp bond hybridization, dipole and charge distributions, formal charge, H-bonding, van der Waals bonding, van der Waals &amp; Pauli exclusion = Lenard Jones potential, associated bond geometries, bond angles &amp; bond length. Composition, molecular formula, constitutional formula, constitutional isomers, configuration, stereoisomers, geometric &amp;optical isomers, conformation; Canonical forms, resonance, hyperconjugation</td>
</tr>
<tr>
<td>3</td>
<td>Functional groups and organic nomenclature – Naming of functional group types, identifying structures, simple examples, name endings, common names and IUPAC names. Classification of organic compounds based on constitution, acyclic and cyclic carbon skeletons, aliphatic, alicyclic, aromatic, heterocyclic compounds. Classification based on functional groups, hydrocarbons, unsaturated hydrocarbons, halogen derivatives, alcohols, ethers, aldehydes, carboxylic acids, amines</td>
</tr>
<tr>
<td>4</td>
<td>Energy vs. Rxn Coordinate diagram, Absolute enthalpy &amp; entropy, transition state theory, Change: Activation enthalpy, entropy &amp; energy; Heat of reaction, Hammond postulate, Bronsted &amp; Hamett equations; Kinetic versus thermodynamic control of reactions; The influence of entropy, vis-a-vis, intramolecular vs. intermolecular rates; The “analogue” concept of reaction progression; The bad habit to consider only “productive” chemical interactions or interactions that feature change.</td>
</tr>
<tr>
<td>5</td>
<td>Chemistry of alkanes and cycloalkanes: Saturated hydrocarbons, paraffins, straight- and branched-chain, alkyl groups, general principles of nomenclature, natural gas, petroleum &amp; products made thereof, gasoline, diesel oil, lubricating oils, Vaseline, tar &amp; asphalt, processes of fractional distillation, thermal decomposition, catalytic cracking, catalytic hydrogenation to make synthetic gasoline, hydrocarbon fuels</td>
</tr>
<tr>
<td>6</td>
<td>Chemistry of alkenes - Alkenes and polyunsaturated compounds, dienes, trienes, polyenes, cumulated, conjugated, and isolated double bonds, cis-trans isomerism in alkenes &amp; cycloalkanes. Electrophilic addition reactions of alkenes with halogens, inorganic acids, hypohalous acids, trans-addition, Markovnikov rule, addition of water using Lewis &amp; Bronsted acids, anti-Markovnikov addition of HBr with peroxides, radical mechanism, hydroboration, hydroxylation of alkenes with KMnO&lt;sub&gt;4&lt;/sub&gt;, cis-addition, epoxidation with peroxycarboxylic acids, 1,2 versus 1,4-addition to conjugated dienes, stabilities of carboations &amp; radicals, tertiary vs. secondary versus primary, rates of ionic processes</td>
</tr>
<tr>
<td>7</td>
<td>Chemistry of alkynes - Nomenclature, reactivities and analogies to alkenes, salt formation affording acetylides in terminal alkynes, production and use of ethyne, reduction processes</td>
</tr>
<tr>
<td>8</td>
<td>Stereoisomerism - Chiral and achiral compounds, enantiomers, diastereomers, meso compounds, racemates, optical activity, concept of plane of symmetry in molecular structure, R,S system and D,L system of nomenclature, absolute &amp; relative configuration, resolution of racemates by chemical means. Conformational changes of alkanes, staggered and eclipsed conformers, anti forms, gauche forms, energy barriers to conformational change, conforma-tion of cycloalkanes particularly cyclohexane, chair forms, chair inversion, half-chair and boat forms, twist boat as an intermediate form in chair inversion.</td>
</tr>
<tr>
<td>9</td>
<td>Alkyl halides, properties, preparation, reactions - Monohaloalkanes, dihalo-, polyhaloalkanes, haloalkenes, fluorocarbons, perfluoroalkanes, vinyl chloride, tetrafluoroethene, polymer reactions affording plastics, polyvinyl chloride, Teflon, other important halogen compounds, solvents, insecticides, weed killers. Nucleophilic substitution of alkyl halides, second-order kinetics versus first-order kinetics, reactions on chiral centers, inversion of configuration, racemization. Organometallic compounds, alkylolithium, alkylimagesium compounds from alkyl halides, reactivity of organometallics</td>
</tr>
<tr>
<td>10</td>
<td>Chemistry of alcohols and ethers – William ether synthesis, preparation and cleavage of ethers, cleavage and reactivity of epoxides, concept of ring strain, alcohols and their synthesis, hydroxylation of alkenes, hydration of alkenes, reduction of carbonyl compounds to afford primary and secondary alcohols, dehydration of tertiary alcohols to yield alkenes, conversion to alkoxide anions, alkyl halides, oxidation to ketones, carboxylic acids, sulphur analogues such as sulphides and thiols, preparation and reactivities</td>
</tr>
<tr>
<td>11</td>
<td>Chemistry of radicals - Halogenation of alkenes by free-radical chain reaction, initiated by hv or heat, initiation, propagation, termination steps; exo &amp; endothermic processes, heat of reaction, energy of activation, transition state, reaction intermediates, factors governing chemical reactions, collision frequency, temperature, molecular weight, orientation factor, alignment, energy factor, kinetic energy &amp; bond breaking. Differing rates in halogenation of primary, secondary &amp; tertiary positions, regioselectivity on basis of radical stabilities, radical’s effect on selectivity</td>
</tr>
</tbody>
</table>
Lectures: 28 lectures will cover the concepts described previously. The scheduling of lectures is as follows:

**Week 1**: 25, 27 September / **Week 2**: 2, 4 October / **Week 3**: 9, 11 October / **Week 4**: 16, 18 October / **Week 5**: 23, 25 October / **Week 6**: 30 October, 1 November / **Week 7**: 6, 8 November / **Week 8**: 20, 22 November / **Week 9**: 27, 29 November / **Week 10**: 4, 6 December / **Week 11**: 11, 13 December / **Week 12**: 18 December / **Week 13**: 25, 27 December / **Week 14**: 3 January / **Week 15**: 8, 10 January

**Lectures are scheduled on:**
- **Tuesdays** from 1:40pm-3:30pm in FENS L035
- **Thursdays** from 3:40pm-4:30pm in FENS L035

**Laboratories:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 October</td>
<td>Melting point and thin-layer chromatography</td>
</tr>
<tr>
<td>15 October</td>
<td>Caffeine isolation</td>
</tr>
<tr>
<td>5 November</td>
<td>Saponification and esterification</td>
</tr>
<tr>
<td>19 November</td>
<td>Nitration of bromobenzene</td>
</tr>
<tr>
<td>3 December</td>
<td>Reaction of benzaldehyde and aniline</td>
</tr>
<tr>
<td>17 December</td>
<td>Sulfonation of toluene and ethylbenzene</td>
</tr>
<tr>
<td>31 December</td>
<td>The aldol condensation</td>
</tr>
</tbody>
</table>

**Laboratories are scheduled on:**

- **Mondays** from 5:40pm-7:30pm in FENS G050. Please note – in our experience, some labs require 2.5h.

- **Your teaching assistants** will be Ayda Onat & Mert Balkan. Please feel free to request their help, should you have questions. However, please do not ask them to perform the experiments.

**Recitations:** With exception to 27 September, 15 November, 20 December & 10 January, all two-hour recitations are scheduled on **Thursdays** from 11:40am-1:30pm in FENS L062.

**How should you study this course?** NS207 is perhaps the most difficult course you will face this term. Please attend class & read a lot (textbook & my website notes, especially the summary of general reactions)

**How should you use the textbook?** Familiarize yourself with the index to find relevant concepts, chemical reactions, etc. In the next few months, we should be able to analyze any reaction and discuss simultaneously the following concepts in detail:

- Bonding, hybridization models, and structure
- Identifying functional groups, degree of substitution (primary, etc.), and naming compounds
- Stereochemistry and chirality
- Very basic IR and NMR spectroscopy
- Understanding reactivity of atoms and functional groups
- Gaining stability by losing accumulated charge or minimizing charge separation
- Maintaining stability by resonance and hyperconjugation
- Manipulating electrons (predicting e-flow) in a reaction from start to finish, yet understanding that it is just a model
- Predicting reactions, products, by-products AND interactions that don’t produce a visible product
- Concept of reaction yield
- Pictorial and diagrammatic representations versus the true situation
- “Digital” reactions versus the true “analogue” situation
- Understanding that your multistep reaction is a simplified model (Okum’s razor)
- Drawing energy versus reaction coordinate diagrams
- Hammond postulate
- Microscopic reversibility
- Thermodynamic versus kinetic control
- Absolute Gibbs energy (chemical potential), Gibbs energy changes and Gibbs energy of activation
- Absolute enthalpy, enthalpy changes and activation enthalpy
- Absolute entropy, Entropy changes and activation entropy
- Apparent/macroscopic observables versus true/theoretical/microscopic parameters