Assignment 3:


- **Functional Group List** on pp 76 and **Periodic Table** Inside front Cover (One page back from Inside Back Cover earlier Editions)
- Chapter 11 – Alcohols and Ethers - nomenclature and properties, prep & reactions
- Chapter 12 – Alcohols from Carbonyl Compounds
- Chapter 16 – Aldehydes and Ketones - Carbonyl Reactions
- Chapter 18 – Aldehydes and Ketones – Reactions at α-Carbon, Aldol
- Chapter 22 – Carbohydrates – read for overview structure and properties


- **Chapter 11**: 11.2; 11.3; 11.5 to 11.7; 11.11 to 11.13; 11.15 to 11.17; 11.20; 11.23; 11.25; 11.26; 11.28; 11.32
- **Chapter 12**: 12.1; 12.3 to 12.8; 12.10; 12.11
- **Chapter 16**: 16.1; 16.4; 16.7; 16.9 to 16.11; 16.17; 16.19; 16.28
- **Chapter 18**: 18.1; 18.2; 18.6a; 18.16; 18.19
- **Chapter 22**: 22.1; 22.2; 22.3; 22.5; 22.20; 22.28

Lecture Outline 3: Alcohols and Ethers, Stereochemistry Review, Aldehydes and Ketones - Properties of the Carbonyl Group

I. Structure, Nomenclature and Physical Properties of Alcohols and Ethers
   A. Aliphatic Alcohols
   B. Aromatic Alcohols (Phenols)
   C. Ethers
   D. Alcohols and Phenols - general properties
      1. MP, BP, solubility, density - hydrogen bonding
      2. Acidity of Aliphatic Alcohols (ROH)
   E. Acidity of Phenols (ArOH) - resonance
   F. Physical Properties of Ethers

II. Review of Stereochemistry - "Fixed three dimensional arrangements" Review Chapter 5
   A. The Concept of Chirality
      1. Identification of chiral objects and molecules - definitions
      2. Types of stereoisomers - enantiomers and diastereomers
      4. Racemic mixtures - 50-50 mixtures of enantiomers
   B. The R and S Nomenclature System
      1. Rules for assignment of R and S configurations
C. Molecules with more than one chiral center
   1. Enantiomers and Diastereomers
   2. Meso compounds - chiral centers with plane of symmetry within molecule
   3. Recognition of chiral centers in complex molecules

III. Structure, Nomenclature, Properties of Aldehydes and Ketones
   A. Nature of the Carbonyl Group - Physical Properties
      1. Polarity and Reactivity
      2. Hybridization and shape (sp\(^2\), planar)
      3. Physical Properties - BP, MP, solubility, smell
   B. Nomenclature of Aldehydes - RCHO
      1. IUPAC - alkane name, replace "e" with "al"
   C. Nomenclature of Ketones - RCOR
      1. IUPAC - alkane name - replace "e" with "one"

IV. Preparation of Aldehydes and Ketones
   A. Aldehydes
      1. Oxidation of Primary Alcohol: RCH\(_2\)OH \rightarrow RCHO
      2. Reduction of Acyl Halides: RCOX \rightarrow RCHO
   B. Ketones
      1. Friedel-Crafts Acylations
      2. Oxidation of 2° Alcohols R\(_2\)CHOH to R\(_2\)CO
      3. With Organometals: RMgX, R\(_2\)Cd, R\(_2\)CuLi

V. Reactions of Aldehydes and Ketones
   A. Nucleophilic Additions at the Carbonyl Carbon Atom
      1. General considerations - strong vs. weak nucleophiles
      2. Cyanohydrin formation
      3. Grignard reagent addition
      4. Reduction (hydride addition)
      5. Hemiacetal and Acetal formation
   B. Nucleophilic Addition - Elimination at the Carbonyl Carbon
      1. Wittig Reaction
      2. Addition of Derivatives of Ammonia: formation of oximes, hydrazones, imines
      3. Cannizzaro Reaction of Aldehydes with no alpha hydrogen
   C. Reactions at the \(\alpha\)-carbon
      1. Enolate formations - Keto - enol tautomerism
      2. Halogenation and Haloform Reaction
      3. Alkylation
      4. Aldol Addition
   D. Reactions of \(\alpha,\beta\)-unsaturated aldehydes and ketones
      1. Conjugate Addition vs Simple Addition

VI. Carbohydrates
   A. Monosaccharides
      1. Classification - aldose, ketose, triose, tetrose, etc.
      2. Stereoisomerism
      3. Anomers and Ring Formation (Hemiacetals, Acetals)
      4. Properties and Sweet Taste
   B. Disaccharides and Polysaccharides
      1. Sucrose
      2. Cellulose, Starch, Glycogen