IUPAC Nomenclature of Branched Alkanes

1. Identify and name the parent chain.
   - The parent chain is the longest consecutive chain of carbon atoms in the molecule.

2. Identify and name all branches off the parent chain as alkyl groups.
   - An alkyl group is an alkane that has had one H atom removed.
   - If the H atom is removed from the end carbon of a straight-chain alkane, the alkyl group is named by changing the –ane suffix of the alkane to –yl.
   - The name(s) of the alkyl group(s) precedes the name of the parent chain.

3. Locate and assign a number to the position of each branch off the parent chain.
   - For a single branch off the parent chain:
     o Count in the direction that gives the lowest number.
     o Place the number in front of the name of the alkyl group, separating the number and name with a hyphen (Example: 3-methyl).
   - For multiple branches off the parent chain:
     o Count in the direction that gives the lowest of number for any branch off the parent chain.
     o For branches of the same type:
       ▪ Indicate the number of that type by using the Greek prefixes di-, tri-, tetra-, etc. in front of the name of the alkyl group.
       ▪ Write the number of the position of each branch in ascending order, separating the numbers by commas.
       ▪ Example: 2,3,3-trimethyl
     o For branches of different types:
       ▪ The alkyl groups are named in alphabetical order, with a number indicating the position of each alkyl group off the parent chain.
       ▪ Example: 3-ethyl-2-methylhexane.

4. Additional Notes
   - The name of an alkane has no spaces.
   - Numbers are separated by commas. Numbers and letters are separated by hyphens.
   - Whether branched or unbranched, alkanes always have a general formula of C\(_n\)H\(_{2n+2}\) and cycloalkanes always have a general formula of C\(_n\)H\(_{2n}\).

IUPAC Nomenclature of Alkenes and Alkynes

Note: Only straight-chain alkenes and alkynes are covered in CHEM 1020.

1. Count the number of carbon atoms in the molecule and write the name of the alkane that has the same number of carbon atoms.
   - For alkenes, drop –ane from the alkane name and replace with the suffix –ene.
   - For alkynes, drop –ane from the alkane name and replace with the suffix –yne.
2. Locate and assign a number to the slot position of the double or triple bond.
   - Count in the direction that gives the lowest number.
   - Place the number in front of the entire name, separating the number and name with a hyphen (Example: 2-pentyne).

3. For alkenes: If the double bond is in any slot position other than the first, you must tell whether the alkene is a cis- or trans- isomer.
   - If the chain builds in each direction on the same side of the double bond, it is cis-.
   - If the chain builds in each direction on opposite sides of the double bond, it is trans-.
   - The prefix cis- or trans- is written before the slot position (Example: trans-2-pentene).

**IUPAC Nomenclature of Alcohols, Aldehydes, Ketones, and Carboxylic Acids**

Note: Only straight-chain oxygen-containing compounds are covered in CHEM 1020.

Each of these families of compounds are named using the following convention:

1. Count the number of carbon atoms in the molecule and write the name of the alkane that has the same number of carbon atoms.
2. Drop –e from the alkane name.
3. If the compound is a(n):
   - **alcohol**, replace with the suffix –ol.
     - The position of the hydroxyl group is numbered if there are three or more carbons.
   - **aldehyde**, replace with the suffix –al.
   - **ketone**, replace with –one.
     - The position of the carbonyl group is numbered.
   - **carboxylic acid**, replace with a suffix of –oic acid.

**Nomenclature of Ethers**

Name each alkyl group attached to the oxygen in alphabetical order, followed by the word ether (Example: butyl ethyl ether). If the two attached alkyl groups are identical, use the prefix di- for the alkyl group (Example: dimethyl ether).

**IUPAC Nomenclature of Esters**

1. The portion of the ester derived from the **alcohol** is named as an **alkyl group**.
2. The portion derived from the **carboxylic acid** named by
   - Dropping –ic acid from the acid name.
   - Replacing with a suffix of –ate.
   - Example: propyl butanoate (derived from 1-propanol and butanoic acid)