

Aldehydes and Ketones (Lecture 1)

1. Aldehydes and Ketones introduction
Definition of carbonyl compounds
Structure of carbonyl compounds
2. Common names for aldehydes and ketones
e.g. like acetaldehyde, benzaldehyde, acetone, benzophenone.
3. IUPAC nomenclature for aldehydes and ketones
Rules for assigning nomenclature
Five to six examples of aldehydes and ketones each e.g.
Methanal, Ethanal, Substituted aldehydes, Propanone, 2-
Butanone etc.
4. Methods for preparation of aldehydes and ketones
 - I. Oxidation of alcohols
Oxidation of primary alcohols give aldehydes
Oxidation of secondary alcohols give ketones
 - II. Catalytic dehydrogenation of alcohols
primary alcohols give aldehydes
secondary alcohols give ketones
Reduction of acyl chlorides

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 657-662.
2. A textbook of Organic Chemistry by Bahl and Bahl, Page No-387-393.

Aldehydes and Ketones (Lecture 2)

Methods of preparation for aldehydes and ketones cont...

III. Oxidation of alkynes

Acetylene gives acetaldehyde while higher alkynes give ketones.

IV. Oxidation of Alkenes (Ozonolysis)

Action of ozone to form ozonides and decomposition to form aldehydes and ketones

V. Hydrolysis of gem dihalides

1,1 dihalo compounds give aldehydes. 2,2 dihalo compounds give ketones.

VI. Catalytic decomposition of acids

Symmetric ketones can be prepared

VII. Oxo Process

Gives aldehydes by reaction of alkene with carbon monoxide and hydrogen

VIII. Wacker Process

It involves treatment of alkene with an acidified aq solution of Pd chloride and cupric chloride

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 662-669.
2. A textbook of Organic Chemistry by Bahl and Bahl, 392-395.

Aldehyde and ketones (Lecture 3)

Reactions of aldehydes and ketones

1. Reactivity of aldehydes and ketones
 - I. Introduction to nucleophilic addition
 - II. Mechanism of nucleophilic addition
 - Base catalysed and acid catalysed addition
 - III. Aldehydes are more reactive than ketones due to inductive and steric effect. Explanation.

2. Reactions of aldehydes and ketones with mechanism
 - I. Addition of alcohols to form acetal
 - II. Addition of HCN to form cyanohydrins

References -

1. Organic Chemistry, Morrison and Boyd, 6th edition, 669-671; 678,680-682.
2. A textbook of Organic Chemistry by Bahl and Bahl, Page No-396-399.

Aldehydes and ketones (Lecture 4)

Reactions of aldehydes and ketones cont...

- III. Addition of ammonia to form amines
 - Mechanism for addition of different ammonia derivatives
- IV. Addition of hydroxylamine to form oximes of aldehydes and ketones
- V. Addition of hydrazine hydrochloride to form hydrazone
- VI. Addition of phenyl hydrazine to form phenyl hydrazone
- VII. Addition of 2,4-Dinitrophenyl hydrazine to form 2,4-Dinitrophenyl hydrazone
- VIII. Addition of semicarbazide to form semicarbazones

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 679-680.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-400-402.

Aldehydes and ketones (Lecture 5)

Reactions of aldehydes and ketones cont....

I X. Addition of Grignard's reagent

Addition of Grignard's reagent to aldehydes produces primary alcohols while addition Grignard's reagent to ketones produces secondary alcohols

XI. Addition of hydride ion

- MPV (Merevein Pondroff Verley) reduction
 - Introduction
 - General reaction
 - Example
 - Mechanism
 - Applications

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 685-687.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-399.
3. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatawal, Himalaya Publishing House, 652-654.

Aldehydes and ketones (Lecture 6)

Oppenaur Oxidation

- Introduction
- General reaction
- Example
- Mechanism
- Applications

References:

1. Reaction Mechanism and Reagents in Organic Chemistry,
Gurdeep R. Chatawal, Himalaya Publishing House, 662-664.

Aldehydes and ketones (Lecture 7)

Aldol Condensation

- Introduction
- General reaction
- Example
- Mechanism
- Crossed aldol condensation
- Example
- Applications

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 805-810.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-402-404.
3. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatawal, Himalaya Publishing House, 593-599.

Aldehydes and ketones (Lecture 8)

Cannizarro's reaction

- Introduction
- General reaction
- Example
- Mechanism
- Crossed cannizarro reaction
- Example
- Applications

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 683-684.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-408.
3. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatawal, Himalaya Publishing House, 606-611.

Aldehydes and ketones (Lecture 9)

1. Reformatsky Reaction

- Introduction
- General reaction
- Example
- Mechanism
- Applications

2. Perkin Reaction

- Introduction
- General reaction
- Example
- Mechanism
- Applications

References:

1. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatawal, Himalaya Publishing House, 670-680; .
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-409.

Aldehydes and ketones (Lecture 10)

Knoevenagel Reaction

- Introduction
- General reaction
- Example
- Mechanism
- Applications

Haloform Reaction

- Introduction
- General reaction
- Example
- Mechanism
- Applications

References:

1. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatawal, Himalaya Publishing House, 640-643.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-407-408.

Aldehydes and ketones (Lecture 11)

Mannich Reaction

- Introduction
 - General reaction
 - Example
 - Mechanism
 - Applications
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- **Revision of aldehydes and ketones**
 - **Discussion on questions asked in the final examination**

References:

1. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatwal, Himalaya Publishing House, 644-654.
2. Advanced General Organic Chemistry, S K Ghosh, Third edition, Part I, 911-916.

Phenols (Lecture 12)

- Introduction to phenols
- Examples of phenols like cresol, catechol, resorcinol etc.
- Properties-
Physical properties
- Acidity of phenols-
Effect of substitution on acidity
- Methods of preparation of phenol
 1. Dow process- from chlorobenzene
 2. From cumene
 3. From sodium benzene sulphonate
 4. From Benzenediazonium salts
 5. From coal tar

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 889-898.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 759-764.

Phenols (Lecture 13)

- Reactions of phenols

A. Reactions of -OH group

1. Salt formation
2. Reaction with FeCl_3
3. Formation of esters
4. Formation of ethers
5. Reaction with Zn dust

B. Reactions of benzene ring

1. Halogenation, Nitration, Sulphonation
2. Friedal Craft acylation and alkylation

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 899-902.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 764-766.

Phenols (Lecture 14)

- **Reactions of benzene ring cont...**
 3. Nitrososation
 4. Sulphonation
 5. Reimer-Tiemann reaction
 6. Oxidation
 7. Catalytic Hydrogenation

- **Uses of phenol**
 1. Preparation of phenol-formaldehyde resins like bakelite
 2. Starting material for synthesis of drugs etc.

- **Revision of phenols**

- **Question paper discussion**

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 899-902.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 766-769.

Alkyl halides (Lecture 15)

- Introduction to alkyl halides
- Classification like 1^o, 2^o and 3^o alkyl halides.
- Structure
- Examples of alkyl halide like Chloromethane, Bromoethane, 1,2-Dichloropropane etc.
- Properties
- Methods of preparations
 1. Halogenation of alkanes in presence of UV light or at high temperature
 2. Addition of Halogen acids to alkene- addition takes place according to Markovnikov rule and anti-Markovnikov rule.
 3. Addition of halogen acids on alcohols

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 168-171.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 707-711.

Alkyl halides (Lecture 16)

- **Methods of preparation cont...**
 4. Action of phosphorus halides on alcohols
 5. Action of thionyl chloride on alcohols
 6. Halogen exchange reaction
- **Introduction to nucleophilic substitution reactions**
- **Substitution Nucleophilic Unimolecular (SN1)**
 1. Introduction
 2. General Reaction
 3. Example
 4. Mechanism
 5. Reaction Kinetics
 6. Energy profile diagram
 7. Stereochemistry

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 168-171; 188-190.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 274-280.
3. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatwal, Himalaya Publishing House, 446-472.

Alkyl halides (Lecture 17)

- **Factors affecting SN¹ reaction**

1. Nature of substrate

- ✓ Stability of Carbocation by inductive effect, hyperconjugative and resonance effect.

2. Nature of solvent

- ✓ Effect of polar and non polar solvents
- ✓ Dielectric constant of solvents

3. Nature of incoming nucleophile

- Nucleophilicity and concentration

4. Nature of leaving group

5. Temperature

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 168-171; 188-190.

2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 279-280.

3. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatwal, Himalaya Publishing House, 446-472.

Alkyl halides (Lecture 18)

- **Substitution Nucleophilic Bimolecular (SN²)**

1. Introduction
2. General Reaction
3. Example
4. Mechanism
5. Reaction Kinetics
6. Energy profile diagram
7. Stereochemistry

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 182-188.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 278-279.
3. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatwal, Himalaya Publishing House, 446-472.

Alkyl halides (Lecture 19)

- **Factors affecting SN² reaction**

1. Nature of substrate

- ✓ Steric effect.

2. Nature of solvent

- ✓ Effect of polar and non polar solvents

3. Nature of incoming nucleophile

- Nucleophilicity and concentration

4. Nature of leaving group

5. Temperature

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 182-188.

2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 278-279.

3. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatwal, Himalaya Publishing House, 446-472.

Alkyl halides (Lecture 20)

- **Substitution Nucleophilic Internal (S_Ni)**

1. Introduction
2. General Reaction
3. Example
4. Mechanism
5. Reaction Kinetics

- **Factors affecting S_Ni reaction**

1. Nature of substrate
2. Nature of solvent
3. Nature of incoming nucleophile
4. Nature of leaving group

References:

1. Advanced General Organic Chemistry, S K Ghosh, Third edition, 585-590.

Alkyl halides (Lecture 21)

- **Reactions of alkyl halides**

1. Reaction with aq. KOH to form alcohols
2. Reaction with moist Silver oxide to form alcohols
3. Reaction with sodium alkoxides to form ethers
4. Reaction with ammonia to form amines
5. Reaction with sodium cyanide to form nitriles
6. Reaction with potassium hydrosulphide (KSH) to form thiols

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 173-174.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 280-282.

Alkyl halides (Lecture 22)

- **Reactions of alkyl halides cont...**

7. Reaction with potassium sulphide (K_2S) to form dialkyl sulphide

8. Reaction with sodium nitrite to form nitroalkanes

9. Reaction with alcoholic KOH to form alkenes-
elimination reaction

- Mechanism

10. Reduction to form alkanes

11. halogenation to form polysubstituted alkyl halides

12. Friedal carft alkylation

- Mechanism

- **Question paper discussion**

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 173-174.

2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 282-284.

Sulphonic acids (Lecture 23)

- Introduction
- Examples
- Properties

- **Methods of preparation**
 1. From sulphonation of benzene and toluene
 2. From sulphonyl chlorides
 3. From thiophenol oxidation

- **Reactions of sulphonic acids**
 1. Salt formation
 2. Ion Reaction with PCl_5 or SOCl_2
 3. Formation of esters

References:

1. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 707-711.

2.

3.

Sulphonic acids (Lecture 24)

- **Reactions of sulphonic acids cont...**
 4. Hydrolysis
 5. Reaction with NaOH
 6. Reaction with NaNH₂
 7. Reaction with NaCN
 8. Reaction with NaSH
 9. Reactions of benzene ring including bromination, nitration and sulphonation

- **Uses of sulphonic acids**

- **Question paper discussion**

References:

1. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 711-712.

2.

3.

Amines (Lecture 25)

- Introduction- definition
- Examples like methanamine, ethanamine
- Classification: 1⁰, 2⁰, 3⁰ and 4⁰ amines; aromatic amines
- Common and IUPAC nomenclature
- Properties
- Basicity of amines
- Methods for preparation giving mixture of amines
 1. Reaction of alkyl halides with ammonia
 2. Reaction of alcohols with ammonia
- Methods for separation of amines
 1. Fractional distillation
 2. Hoffmann method
 3. Hinsberg method

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 821-830.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No- 548-550, 554-556.

Amines (Lecture 26)

- Methods for preparation of primary amines
 1. Reduction of nitro alkanes
 2. Reduction of nitriles
 3. Reduction of oximes
 4. Reduction of amides
 5. Hoffmann's degradation of amides
- Mechanism
- 6. Gabriel phthalimide synthesis
- 7. Reductive amination of aldehydes

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 821-830.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-550-552.

Amines (Lecture 27)

- **Methods of preparation of secondary amines**

1. Reaction of primary amines with alkyl halides
2. Reduction of N-substituted amides
3. Reduction of isonitriles
4. Reductive amination of aldehydes or ketones

- **Methods for preparation of tertiary amines**

1. Reaction of alkyl halides with ammonia
2. Reduction of N,N-disubstituted amides
3. Decomposition of tetraalkylammonium hydroxides

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 821-830.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-552-553.

Amines (Lecture 28)

- **Reactions of amines**

1. Salt formation
2. Reaction with alkyl halides
3. Reaction with acyl chlorides
4. Carbylamine reaction- used to distinguish primary amines from secondary and tertiary amines
5. Reaction with carbon disulphide to form alkyl isothiocyanate

- **Distinguishing tests for 1^o, 2^o and 3^o amines**

1. Reaction with nitrous acid (nitrous acid test)
2. Reaction with benzene sulphonyl chloride (Hinsberg test)

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 845-849.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-558-560.

Amines (Lecture 29)

- **Aromatic amines**
- Introduction
- Examples like aniline, o-toluidine
- Basicity of amines
- **Methods of preparation**
 1. Reduction of nitro compounds
 2. Ammonolysis of aromatic chlorides
 3. Hofmann rearrangement
 4. Reduction of diazocompounds
- **Reactions**
 1. Salt formation
 2. Alkylation
 3. Acylation
 4. Carbylamine reaction
 5. Reaction with nitrous acid
 6. Electrophilic substitution reactions like halogenations, nitration, sulphonation etc.
- **Preparation and use of diazonium salts**

References:

1. Organic Chemistry, Morrison and Boyd, 6th edition, 866-869.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-558-560.

Cyanides and Isocyanides (Lecture 30)

- Introduction
- Common examples
- Structure
- Nomenclature
- Properties
- **Preparation of cyanides**
 1. Dehydration of amides
 2. From Grignard's reagent
 3. By reaction of alkyl halide with potassium cyanide
- **Preparation of isocyanates**
 1. By carbylamines reaction- reaction of amine with chloroform and NaOH
 2. Reaction of alkyl iodide and silver cyanide
 3. Dehydration of N-alkyl formamide

References:

- 1.
- 2.
- 3.

Cyanides and Isocyanides (Lecture 31)

- **Reactions of Cyanides and Isocyanides**

1. Hydrolysis
 - Cyanides on hydrolysis give carboxylic acids via amides
2. Reduction
 - Alkyl cyanides give primary amines
 - Alkyl isocyanides give secondary amines
3. Addition of ammonia
 - Alkyl cyanides form amidines
4. Reaction of alkyl cyanides with acid anhydrides
5. Action of heat on isocyanide to form more stable cyanides.
6. Addition of sulphur to isocyanide to form alkyl isothiocyanates

Carboxylic Acids (Lecture 32)

- Introduction to carboxylic acids
- Common and IUPAC nomenclature
- Properties
- Acidity of carboxylic acids

- **Methods of preparation**
 1. Oxidation of primary alcohols or aldehydes
 2. Hydrolysis of Nitriles
 3. Hydrolysis of esters
 4. Reaction of Grignard reagent with CO₂
 5. Carboxylation of Alkenes
 6. Malonic ester synthesis

- **References:**
 1. Organic Chemistry, Morrison and Boyd, 6th edition, 713-722.
 2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-426-431.

Carboxylic Acids (Lecture 33)

- **Reactions of carboxylic acids**

1. Salt formation
2. Formation of acid halides
3. Formation of amides
4. Formation of esters
5. Formation of Anhydrides
6. Reduction
7. Halogenation

- **References:**

1. Organic Chemistry, Morrison and Boyd, 6th edition, 725-728.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-426-431.

Carboxylic Acids (Lecture 34)

- Aromatic carboxylic acids
- Introduction
- Examples

- **Preparation**
 1. By oxidation of alkylbenzenes
 2. By reaction of aryl Grignard's reagent with CO₂
 3. By acid hydrolysis of benzonitriles
 4. By basic hydrolysis of benzotrichlorides

- **Reactions**
 1. Salt formation
 2. Ester formation
 3. Acyl halide formation
 4. Reduction
 5. Decarboxylation

- **References:**
 1. Organic Chemistry, Morrison and Boyd, 6th edition, 721-728.
 2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-798-801.

Carboxylic Acids (Lecture 35)

- **Acid halides**
- Introduction
- Examples

- **Methods of preparation**
 1. By reaction of thionyl chloride and acid
 2. By reaction of acid with PCl_3 and PCl_5

- **Reactions:**
 1. Hydrolysis to give acids
 2. Reaction with alcohol to form ester
 3. Ammonolysis to form amides
 4. Reaction with amines
 5. Reaction with salt of carboxylic acids to form anhydrides
 6. Reduction

- **References:**
 1. Organic Chemistry, Morrison and Boyd, 6th edition, 760-762.
 2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-477-480.

Carboxylic Acids (Lecture 36)

- **Anhydrides**
- **Introduction**
- Examples
- Nomenclature

- **Methods of preparation**
 1. By reaction of acid halides with carboxylic acids
 2. By reaction of acid halides with salt of carboxylic acids

- **Reactions**
 1. Hydrolysis to form acids
 2. Reaction with alcohols
 3. Reaction with ammonia
 4. Reaction with amines
 5. Friedel Craft reaction

- **References:**
 1. Organic Chemistry, Morrison and Boyd, 6th edition, 763-765.
 2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-481-483.

Carboxylic Acids (Lecture 37)

- **Esters**
 - Introduction
 - Common and IUPAC nomenclature

- **Preparation**
 1. By Fischer esterification-Reaction of carboxylic acids with alcohols
 2. By reaction of acid chlorides with alcohols
 3. By reaction of acid anhydrides with alcohols
 4. Reaction of carboxylic acids with diazomethane
 5. By reaction of carboxylate salts and alkyl halides

- **Reactions**
 1. Hydrolysis- acid and base hydrolysis with mechanism
 2. Ammonolysis
 3. Reduction to alcohols
 4. Reaction with Grignard reagent to form alcohol
 5. Claisen condensation

- **References:**
 1. Organic Chemistry, Morrison and Boyd, 6th edition, 768-773.
 2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-496-501.

Carboxylic Acids (Lecture 38)

- **Amides**
- Introduction
- Examples
- Common and IUPAC nomenclature
- **Preparation**
 1. By reaction of ammonia and acid chlorides
 2. By reaction of ammonia on anhydrides
 3. By heating Ammonium Carboxylates
- **Reactions**
 1. Hydrolysis to form acid
 2. Reaction with nitrous acid to form acid
 3. Reduction to form amine
 4. Dehydration to form nitriles
 5. Hofmann's degradation

- **References:**

1. Organic Chemistry, Morrison and Boyd, 6th edition, 766-768.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-484-486.

Carboxylic Acids (Lecture 39)

- **Dicarboxylic acids**
- Introduction
- Examples
- **Preparation**
 1. By cyanide synthesis
 2. By oxidation of cyclic ketones
 3. By Malonic estersynthesis
 4. By acetoacetic ester synthesis
- **Reactions**
 1. Action of heat
 2. Salt formation
 3. Formation of esters
 4. Formation of amides
 5. Formation of acid halides

- **References:**

1. Organic Chemistry, Morrison and Boyd, 6th edition, 742-743.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-452-455.

Alcohols and Ethers (Lecture 40)

- **Alcohols**
- Introduction
- Common and IUPAC nomenclature
- **Preparation**
 1. By Hydrolysis of alkyl halides
 2. By Hydration of alkenes
 3. By Hydroboration-oxidation of alkenes
 4. By Hydrolysis of esters
 5. Reduction of aldehydes and ketones
 6. Addition of Grignard's reagent to aldehydes and ketones
 7. Fermentation

- **References:**

1. Organic Chemistry, Morrison and Boyd, 6th edition, 214-223
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-315-323.

Alcohols and Ethers (Lecture 41)

- **Reactions of alcohols**

1. Reaction with active metal
2. Reaction with phosphorus halides
3. Reaction with thionyl chloride
4. Reaction with hydrogen halides
5. Reaction with nitric acid
6. Dehydration to form alkenes
7. Dehydration of two molecules to form ethers
8. Reaction with carboxylic acids to form esters
9. Reaction with acid halides/ anhydrides to form esters
10. Reaction with Grignard's reagent
11. Oxidation
12. Reduction

- **References:**

1. Organic Chemistry, Morrison and Boyd, 6th edition, 224-226.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-323-326; 362-365

Alcohols and Ethers (Lecture 42)

- **Ethers**

- Introduction
- Common and IUPAC nomenclature

- **Preparation**

1. Dehydration of alcohols
2. Williamson Ether synthesis
3. Action of Diazomethane on alcohols
4. Heating Alkyl halides with Dry silver oxide

- **Reactions**

1. Formation of Oxonium salts
2. Autooxidation to form peroxides
3. Hydrolysis to form alcohols
4. Reaction with PCl_5
5. Reaction with Conc. HI or HBr
6. Reaction with acetyl chloride

- **References:**

1. Organic Chemistry, Morrison and Boyd, 6th edition, 237-243.
2. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-366-368.

Esters and Amides (Lecture 43)

- **Esters and Amides**

- Claisen Condensation

- ✓ Introduction
- ✓ General reaction
- ✓ Example
- ✓ Mechanism
- ✓ Crossed Claisen condensation
- ✓ Applications

- **Dieckmann reaction**

- ✓ Introduction
- ✓ General reaction
- ✓ Example
- ✓ Mechanism
- ✓ Applications

- **References:**

1. Pharmaceutical Organic Chemistry Simplified, K S Jain, P B Miniyar and A R Shaikh, 7.1-7.3.

2. Reaction Mechanism and Reagents in Organic Chemistry, Gurudeep Chatwal, 611-617.

Esters and Amides (Lecture 44)

- **Use of acetoacetic ester in synthesis**

1. Synthesis of alkylacetic acids
2. Synthesis of succinic acid
3. Synthesis of diacids
4. Synthesis of unsaturated acids
5. Synthesis of methyl ketone

- **Use of Malonic ester in synthesis**

1. Synthesis of alkylacetic acids
2. Synthesis of succinic acid
3. Synthesis of diacids
4. Synthesis of unsaturated acid

References:

1. A textbook of Organic Chemistry by Bahl and Bahl, S Chand and Company Ltd., Page No-520-521; 528-529.
2. Pharmaceutical Organic Chemistry Simplified, K S Jain, P B Miniyar and A R Shaikh, 7.4-7.6.

Esters and Amides (Lecture 45)

- **Michael Addition**

1. Introduction
2. General reaction
3. Example
4. Mechanism
5. Applications

- **Addition of Grignard's Reagent**

1. Reaction
2. Mechanism

- **Ammonolysis of esters**

References:

1. Pharmaceutical Organic Chemistry Simplified, K S Jain, P B Miniyar and A R Shaikh, 7.6-7.9.