UNIT 11

11.1  (i) 2,2,4-Trimethylpentan –3-ol  
(vii) 2,5 – Dimethylphenol  
(x) Ethoxybenzene  
(xii) 2 –Ethoxybutane

11.2  (i) CH₃ – C – CH₂ – CH₃  
(v) C₇H₆ – O – CH₃ – CH₂ – CH₃

11.3  (a) CH₃CH₂CH₂CH₂CH₂OH,  Pentan-1-ol;  
(b) CH₃–CH₂–CH–CH₂–CH₂–OH, 2-Methylbutan-1-ol;  
(c) CH₃–C–CH₂OH,  2,2-Dimethylpropan-1-ol

11.4  Hydrogen bonding in propanol.
11.5 Hydrogen bonding between alcohol and water molecules.
11.8 o-Nitrophenol is steam volatile because of intramolecular hydrogen bonding.
11.12 **Hint:** Carryout sulphonation followed by nucleophilic substitution.

11.13 (i) 

\[
\text{CH}_2\text{Cl} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{OH}
\]

(ii) 

\[
\text{CH}_2\text{Cl} + \text{NaOH} \rightarrow \text{CH}_3\text{OH} + \text{NaCl}
\]

(iii) 

\[
\text{CH}_3\text{Cl} + \text{NaOH} \rightarrow \text{CH}_3\text{OH} + \text{NaCl}
\]

11.14 Reaction with (i) sodium and (ii) sodium hydroxide

11.15 Due to electron withdrawing effect of nitro group and electron releasing effect of methoxy group.

11.20 (i) Hydration of Propene.

(ii) By nucleophilic substitution of –Cl in benzyl chloride using dilute NaOH.

(iii) 

\[
\text{C}_7\text{H}_5\text{MgBr} + \text{HCHO} \rightarrow \text{C}_7\text{H}_5\text{CH}_2\text{OMgBr} \xrightarrow{\text{H}_2\text{O}} \text{C}_7\text{H}_5\text{CH}_2\text{OH}
\]

(iv) 

\[
\text{CH}_3\text{MgBr} + \text{CH}_2\text{COCH}_3 \rightarrow \text{CH}_3\text{C} - \text{OBr} \xrightarrow{\text{H}_2\text{O}} \text{CH}_3\text{C} - \text{OH}
\]

11.23 (i) 1-Ethoxy-2-methylpropane.

(ii) 2-Chloro-1-methoxymethane.

(iii) 4-Nitroanisole.

(iv) 1-Methoxypropane.

(v) 1-Ethoxy-4,4-dimethylcyclohexane.

(vi) Ethoxybenzene.

**UNIT 12**

12.2 (i) 4-Methylpentanal

(iii) But-2-enal

(v) 3,3,5-Trimethylhexan-2-one

(vii) Benzene –1,4-dicarbaldehyde

12.3 (i) 

\[
\text{H}_2\text{C} - \text{CH} - \text{CH}_2 - \text{C} - \text{H}
\]

(iii) 

\[
\text{H}_2\text{C} - \text{C} - \text{CH} - \text{CH}_2 - \text{C} - \text{H}
\]

(v) 

\[
\text{H}_2\text{C} - \text{C} - \text{CH}_2 - \text{CH} - \text{CH}_2
\]

(ii) 

\[
\text{O} - \text{N} - \text{C} - \text{CH}_2 - \text{CH}_3
\]

(iv) 

\[
\text{H}_2\text{C} - \text{C} = \text{C} - \text{CH}_3
\]

(vi) 

\[
\text{H}_2\text{C} - \text{CH} - \text{CH} - \text{CH}_2 - \text{C} - \text{OH}
\]
12.4  
(i) Heptan-2-one  
(ii) 4-Bromo-2-methylhexanal  
(iii) Heptanal  
(iv) 3-Phenylpropenal  
(v) γ-Cyclopentanecarbaldehyde  
(vi) Diphenylmethanone

12.5  
(i)  
(ii)  
(iii) CH₂CH₇OCH₃  
(iv)  
(v) H₃C–CH₂–CH(CH₃)–CH₂–CH₃

12.6  
(i)  
(ii)  
(iii) CH=NNH–C–NH₂  
(iv) OC₆H₅  
(v) C₇H₈

12.7  
(ii), (v), (vi), (vii): Aldol condensation.  
(i), (iii), (ix) Cannizaro reaction.  
(iv), (viii) Neither.

12.10  
2-Ethylbenzaldehyde (draw the structure yourself).

12.11  
(A) CH₃CH₂CH₂COOCH₂CH₂CH₂CH₃, butyl butanoate.  
(B) CH₃CH₂CH₂COOH  
(C) CH₃CH₂CH₂CH₂OH. Write equation yourself.

12.12  
(i) Di-tert-butyl ketone < Methyl tert-butyl ketone < Acetone < Acetaldehyde  
(ii) (CH₃)₂CHCOOH < CH₃CH₂CH₂COOH < CH₃CH(Br)CH₂COOH < CH₃CH₂CH(Br)COOH  
(iii) 4-Methoxybenzoic acid < Benzoic acid < 4-Nitrobenzoic acid < 3,4-Dinitrobenzoic acid.

12.17  
(i)  
(ii)  
(iii) C₆H₅CH=NNH–NH₂  
(iv) C₆H₅COCl–AlCl₃  
(v)  
(vi)  
(vii) C₆H₅CH=CH–CHO  
(viii) CH₃CH(OH)CH₂COOC₂H₅  
(ix)  
(x) 1. BH₃; 2. H₂O₂/ÖH; 3. PCC  
(xi)  

12.19  
The compound is methyl ketone and its structure would be: CH₃COCH₂CH₂CH₃
UNIT 13

13.1 (i) 1-methylethanamine (ii) Propan-1-amine
(iii) N-methyl-2-methylethanamine (iv) 2-methylpropan-2-amine
(v) N-methylbenzamine or N-methylaniline (vi) N-Ethyl-N-methylethanamine
(vii) 3-Bromoaniline or 3-Bromobenzenamine

13.4 (i) \( C_6H_5NH_2 < C_6H_5NHCH_3 < C_2H_5NH_2 < (C_2H_5)_2NH \)
(ii) \( C_6H_5NH_2 < C_6H_5N(CH_3)_2 < CH_3NH_2 < (C_2H_5)_2NH \)
(iii) (a) p-nitroaniline < aniline < p-toluidine
(b) \( C_6H_5NH_2 < C_6H_5NHCH_3 < C_6H_5CH_2NH_2 \)
(iv) \( (C_6H_5)_2N > (C_6H_5)_2NH > C_6H_5NH_2 > NH_3 \)
(v) \( CH_3)_2NH < C_6H_5NH_2 < C_2H_5OH \)
(vi) \( C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2 \)

UNIT 15

15.1 Polymer is a high molecular mass macromolecule consisting of repeating structural units derived from monomers.
Monomer is a simple molecule capable of undergoing polymerisation and leading to the formation of the corresponding polymer.

15.2 Natural polymers are high molecular mass macromolecules and are found in plants and animals. The examples are proteins and nucleic acids.
Synthetic polymers are man-made high molecular mass macromolecules. These include synthetic plastics, fibres and rubbers. The two specific examples are polythene and dacron.

15.4 Functionality is the number of bonding sites in a monomer.

15.5 Polymerisation is a process of formation of a high molecular mass polymer from one or more monomers by linking together of repeating structural units with covalent bonds.

15.6 Since the unit \( –\text{NH}–\text{CHR–CO}– \) is obtained from a single monomer unit, it is a homopolymer.

15.7 On the basis of molecular forces present between the chains of various polymers, the classification of polymers is given as follows.
(a) Elastomers (b) Fibres (c) Thermoplastics and (d) Thermosetting plastics.

15.8 In addition polymerisation, the molecules of the same or different monomers add together to form a large polymer molecule. Condensation polymerisation is a process in which two or more bi-functional molecules undergo a series of condensation reactions with the elimination of some simple molecules and leading to the formation of polymers.

15.9 Copolymerisation is a process in which a mixture of more than one monomeric species is allowed to polymerise. The copolymer contains multiple units of each monomer in the chain. The examples are copolymers of 1,3-butadiene and styrene and 1, 3-butadiene and acrylonitrile.

15.10

\[
\begin{align*}
\text{C}_6\text{H}_5\text{C}=\hat{\text{O}} & \quad \xrightarrow{\text{C}_6\text{H}_5\text{C}–\hat{\text{O}}} \quad 2\text{C}_6\text{H}_5\text{C}–\hat{\text{O}} \\
\text{C}_6\text{H}_5\text{C}–\hat{\text{O}} \quad \xrightarrow{\text{C}_6\text{H}_5\text{C}–\hat{\text{O}}} \quad 2\text{C}_6\text{H}_5
\end{align*}
\]

phenyl radical

\[
\begin{align*}
\text{C}_6\text{H}_5\text{C}–\hat{\text{O}} & \quad \xrightarrow{\text{C}_6\text{H}_5\text{C}–\hat{\text{O}}} \quad \text{C}_6\text{H}_5\text{C}–\hat{\text{O}} \\
\text{C}_6\text{H}_5\text{C}–\hat{\text{O}} \quad \xrightarrow{\text{C}_6\text{H}_5\text{C}–\hat{\text{O}}} \quad \text{C}_6\text{H}_5\text{C}–\hat{\text{O}}
\end{align*}
\]

chain termination

\[
\begin{align*}
\text{C}_6\text{H}_5\text{C}–\hat{\text{O}} & \quad \xrightarrow{\text{C}_6\text{H}_5\text{C}–\hat{\text{O}}} \quad \text{C}_6\text{H}_5\text{C}–\hat{\text{O}} \\
\text{C}_6\text{H}_5\text{C}–\hat{\text{O}} \quad \xrightarrow{\text{C}_6\text{H}_5\text{C}–\hat{\text{O}}} \quad \text{C}_6\text{H}_5\text{C}–\hat{\text{O}}
\end{align*}
\]

Polystyrene

15.11 A thermoplastic polymer can be repeatedly softened on heating and hardened on cooling, hence it can be used again and again. The examples are polythene, polypropylene, etc.
A thermosetting polymer is a permanent setting polymer as it gets hardened and sets during
moulding process and cannot be softened again. The examples are bakelite and melamine-formaldehyde polymers.

15.12 (i) The monomer of polyvinyl chloride is CH₂=CHCl (vinyl chloride).
(ii) The monomer of teflon is CF₂=CF₂ (tetrafluoroethylene).
(iii) The monomers involved in the formation of bakelite are HCHO (formaldehyde) and C₆H₅OH (phenol).

15.14 From the structural point of view, the natural rubber is a linear cis-1,4- polyisoprene. In this polymer the double bonds are located between C₂ and C₃ of isoprene units. This cis-configuration about double bonds do not allow the chains to come closer for effective attraction due to weak intermolecular attractions. Hence, the natural rubber has a coiled structure and shows elasticity.

15.16 The monomeric repeat unit of Nylon-6 polymer is:
[NH–(CH₂)₅–CO]

The monomeric repeat unit of Nylon-6,6 polymer is derived from the two monomers, hexamethylene diamine and adipic acid.
[NH–(CH₂)₆–NH–CO–(CH₂)₄–CO]

15.17 The names and structures of monomers are:

<table>
<thead>
<tr>
<th>Polymers</th>
<th>Monomer Names</th>
<th>Monomer Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Buna-S</td>
<td>1,3-Butadiene</td>
<td>CH₂=CH-CH=CH₂</td>
</tr>
<tr>
<td></td>
<td>Styrene</td>
<td>C₆H₅CH=CH₂</td>
</tr>
<tr>
<td>(ii) Buna-N</td>
<td>1,3-Butadiene</td>
<td>CH₂=CH-CH=CH₂</td>
</tr>
<tr>
<td></td>
<td>Acrylonitrile</td>
<td>CH₂=CH-CN</td>
</tr>
<tr>
<td>(iii) Neoprene</td>
<td>Chloroprene</td>
<td>CH₂=CH-CN</td>
</tr>
<tr>
<td>(iv) Dacron</td>
<td>Ethylene glycol</td>
<td>OHCH₂-CH₂OH</td>
</tr>
<tr>
<td></td>
<td>Terephthalic acid</td>
<td>COOH-</td>
</tr>
</tbody>
</table>

15.18 The monomers forming the polymer are:
(i) Decanoic acid HOOC-[(CH₂)₈-COOH and Hexamethylene diamine H₂N[CH₂]₆ NH₂

(ii) and HCHO

15.19 The following are the equations for the formation of Dacron.

\[ n \text{HOCH}_2\text{CH}_2\text{OH} + n\text{HOOC} \xrightarrow{\text{Terephthalic acid}} \{ \text{O-CH}_2\text{CH}_2\text{O-CO} \xrightarrow{\text{Dacron}} \} \_n \]