

SEMESTER VI -BIOCHEMISTRY

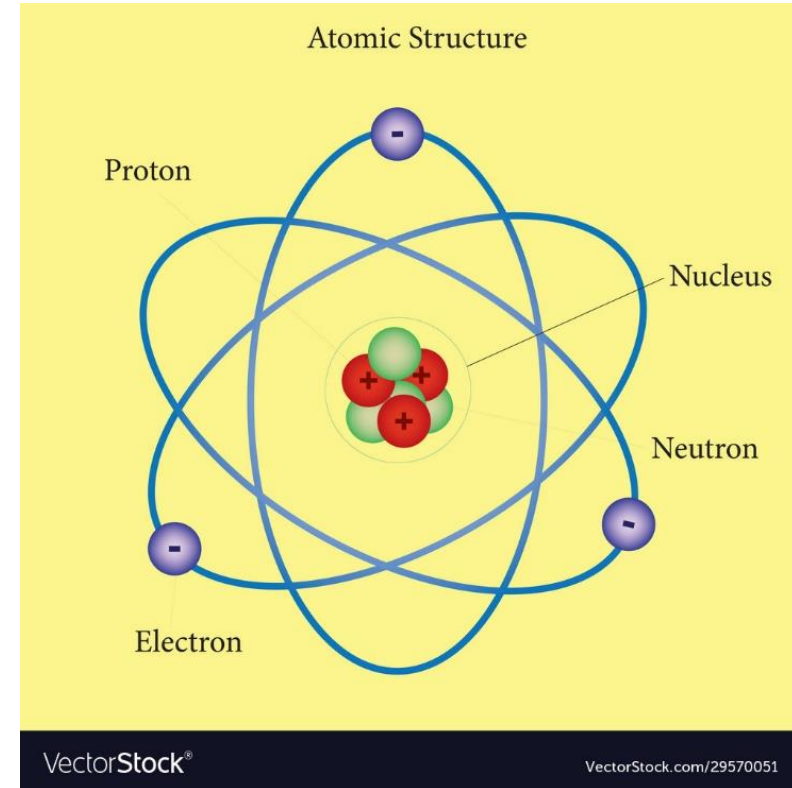
# STABILIZING FORCES OF BIOMOLECULES

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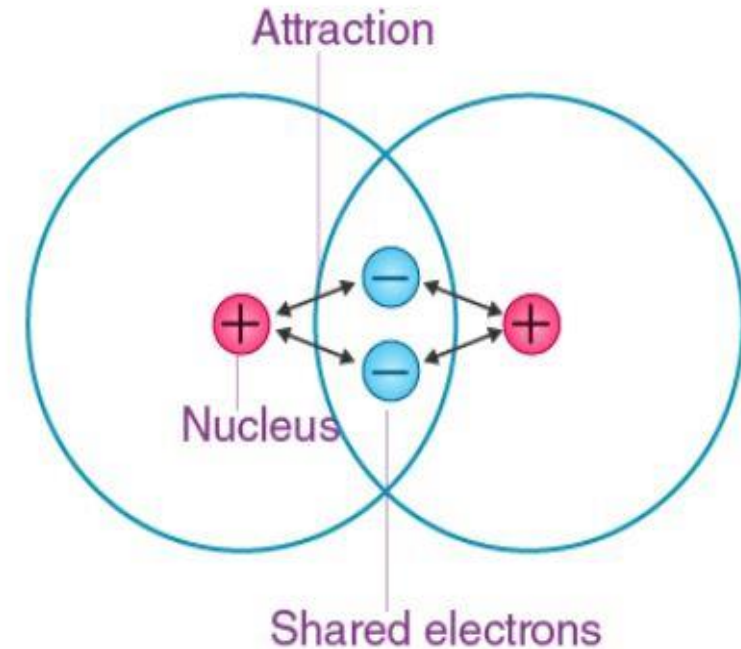
# Chemical Bonds

- Attraction forces between atoms ,strong enough to permit the combination of atoms to function as a single unit.
- It originate due to the attraction of electrons and atomic nuclei(Coulombic interactions).
- Major stabilizing forces are two types covalent and non covalent.



# A. Covalent bonds

- In this bond electrons are shared by two atomic nuclei.
- These electron pairs are known as **shared pairs** or **bonding pairs**.
- The bonding electrons are relatively localized in the region of the two nuclei.
- Single covalent bond includes sharing of two electrons ,double bond has 4shared electrons ,and triple bond has 6 electrons.



Formation of Covalent Bond

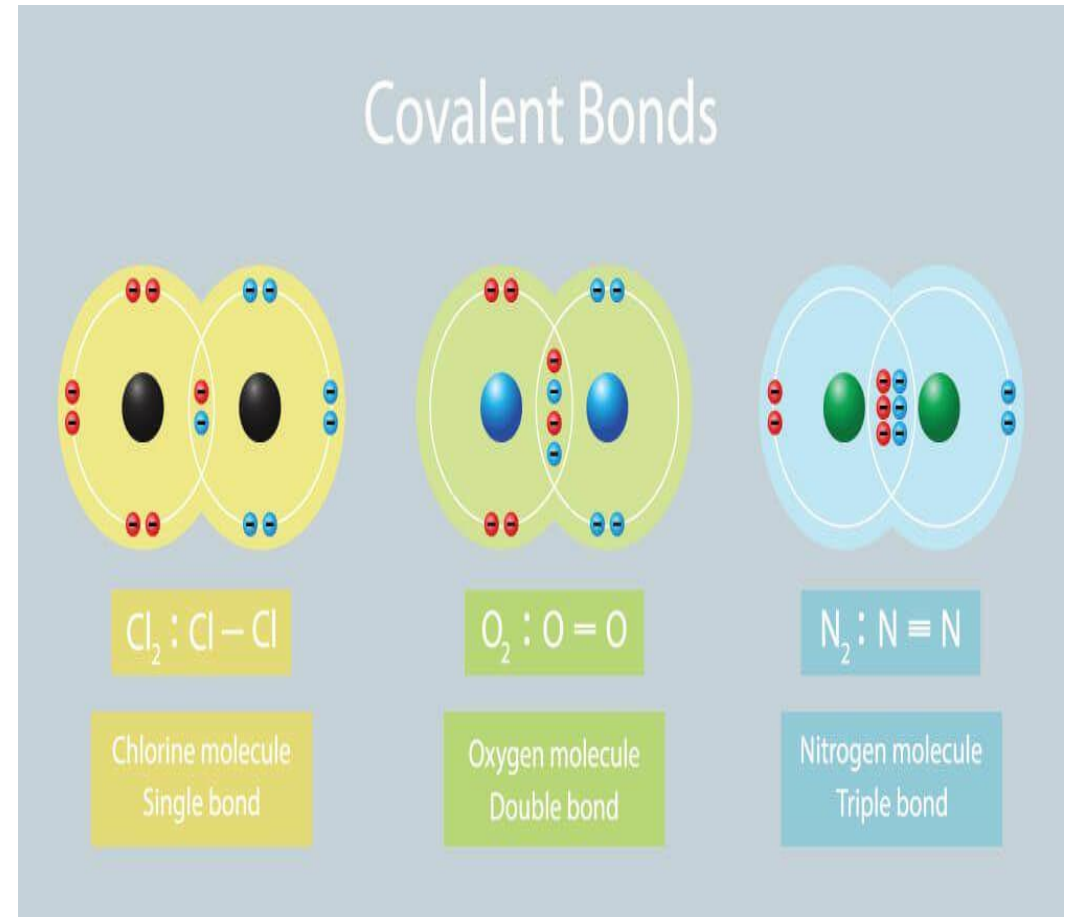
- Ester bond in nucleic acids ,peptide bond and disulphide bond in proteins,and Glycosidic bond in carbohydrates are examples of covalent bonds

Two types : Polar and Non-Polar

### Nonpolar Covalent Bond

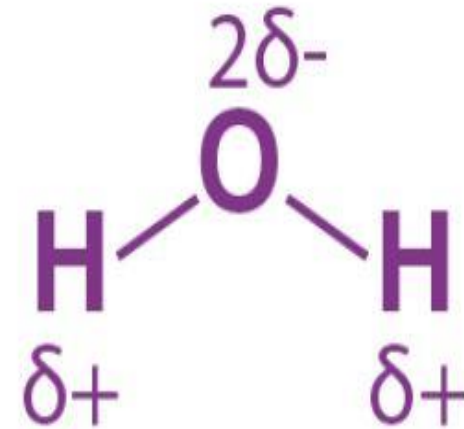
This type of covalent bond is formed whenever there is an equal share of electrons between atoms.

**Example,** Nonpolar Covalent Bond is found in gas molecules like Hydrogen gas, Nitrogen gas, etc.



## Polar Covalent Bond

- This type of covalent bond exists where the unequal sharing of electrons occurs due to the difference in the electronegativity of combining atoms. More electronegative atom will have a stronger pull for electrons.
- **Example**, molecules forming hydrogen bonding as a result of an unbalanced electrostatic potential. In this case, the hydrogen atom interacts with electronegative fluorine, hydrogen, or oxygen.



Polarity of Covalent Bond in Water Molecule

## B. Non- Covalent Interactions

- They are weak and non- specific in nature.
  - They are significant in producing macromolecular structures ,stabilizing transition states of biochemical reactions ,folding proteins to 3D structures etc.
  - They can be **Intra molecular** ( within the same molecules) and **inter molecular** (Between different molecules)
- It include:
    1. Electrostatic or Ionic bonds
    2. Hydrogen Bonds
    3. Hydrophobic interactions
    4. Van –der Wall’s interactions

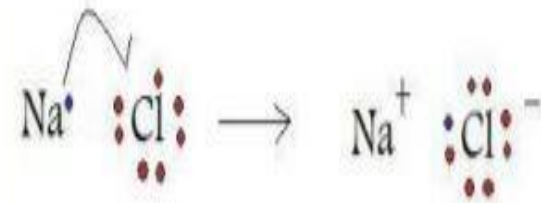
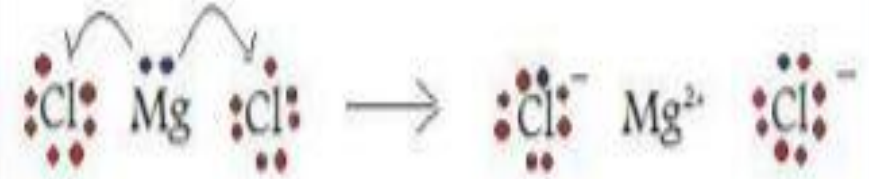
# 1. Electrostatic or Ionic Bonds

- Ionic bonding is the complete transfer of valence electron(s) between atoms.
- Ionic bonds require an electron donor, often a metal, and an electron acceptor, a non-metal.
- In ionic bonds, the metal loses electrons to become a positively charged cation, whereas the non-metal accepts those electrons to become a negatively charged anion.



## Salt bridges

special type of ionic bond formed between positively charged amino acids (e.g. Arginine, Lysine) and negatively charged amino acids (Aspartic acid, Glutamic acid) in proteins. Helps to stabilize proteins.



## 2. Hydrogen Bonds

- Hydrogen bonding is a special type of dipole-dipole attraction between molecules.
- It results from the attractive force between a hydrogen atom covalently bonded to a very electronegative atom such as a N, O, or F atom and another very electronegative atom.

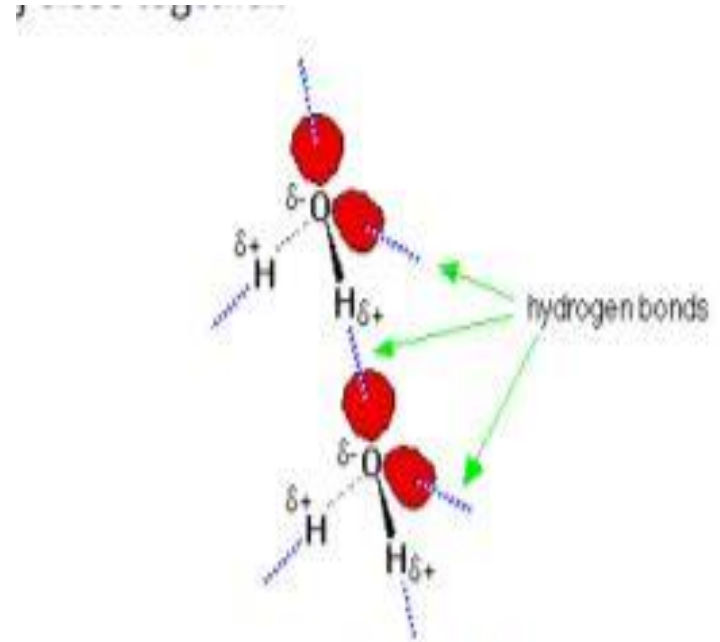


Figure 4: Hydrogen bonding in water

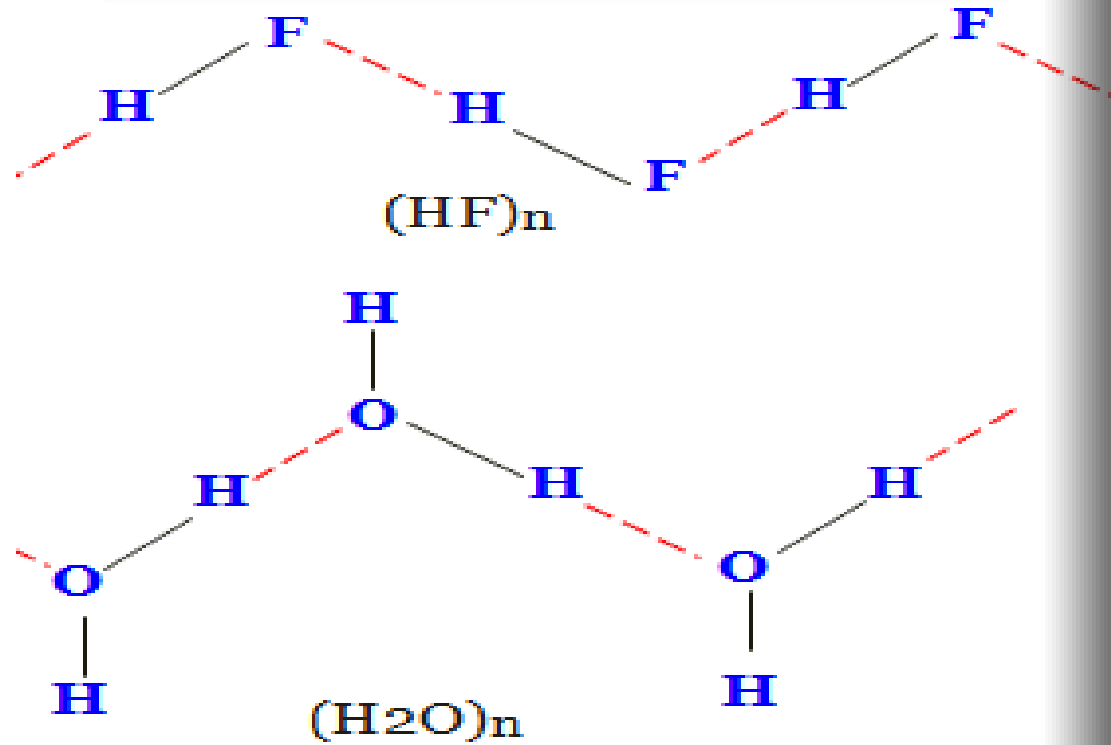
- Inter molecular H bonding
- Hydrogen bonding between the different molecules of same substance or different substances.
- Intermolecular H bonding causes the association of molecules
- Eg). Hydrogen Bonding in HF

Hydrogen bonding in Water molecule

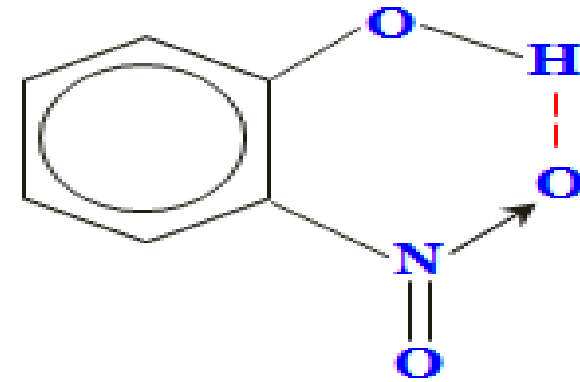
- Intra molecular H bonding
- Hydrogen bonding within the molecule.
- Eg). H bonding in Salicylic acid and o-nitrophenol.

# Hydrogen Bonding

## Intramolecular H-bonding



## Intramolecular H-bonding



### 3).Hydrophobic Interactions

- Hydrophobic are nonpolar molecules and usually have a long chain of carbons that do not interact with water molecules.
- Hydrophobic interactions are those interactions either between non-polar molecules or between non-polar parts of amphipathic molecules, which have no affinity for water and hence would be repelled by water.
- Many biomolecules such as proteins ,sterols etc shows hydrophobicinteractions

## 4).Van der Waals interactions

- Weakest intermolecular attraction force among biomolecules
- Mainly three types:
- **Dipole- dipole forces** = Dipole-dipole forces are attractive forces between the positive end of one polar molecule and the negative end of another polar molecule.
- **Dipole –Induced Dipole** = A **dipole-induced dipole** attraction is a weak attraction that results when a polar molecule induces a **dipole** in an atom or in a nonpolar molecule by disturbing the arrangement of electrons in the nonpolar species.
- **Induced Dipole – Induced Dipole** = Attractive interactions between the instantaneous fluctuating dipoles induced in atoms or non polar molecules by proximity of atoms or nonpolar molecules these are the weakest among vanderwalls interactions

THANK YOU