PARALLEL ROBOTICS:

A parallel robot is a robotic mechanism in which the end-effector (moving platform) is connected to a fixed base by two or more independent kinematic chains (also called limbs or legs) that operate in parallel. Unlike serial robots, where joints are arranged one after another, parallel robots share the load among multiple chains.

STRUCTURE OF A PARALLEL ROBOT:

A typical parallel robot consists of:

1. **Fixed base** – stationary reference frame
2. **Moving platform (end-effector)** – performs the task
3. **Multiple kinematic chains (legs)** – connect base to platform
4. **Actuators** – usually placed near the base
5. **Joints** – revolute, prismatic, spherical, or universal joints

TYPES OF PARALLEL ROBOTS:

1. **Planar Parallel Robots**

- Motion confined to a plane
- Example: Five-bar linkage
- Used in research and educational setups

2. **Spatial Parallel Robots**

- Motion in three-dimensional space
- Example: Stewart Platform (Hexapod)

3. **Delta Robots**

- Three identical arms connected to a triangular platform
- Provides pure translational motion
- Very high speed and acceleration

4. **Cable-Driven Parallel Robots**

- Rigid links replaced by cables
- Large workspace and low inertia
- Used in stadium cameras and construction applications

ADVANTAGES OF PARALLEL ROBOTS:

- High stiffness and structural rigidity
- High positioning accuracy

- High load-carrying capacity
- High speed and acceleration
- Actuators mounted near base → reduced inertia

DISADVANTAGES OF PARALLEL ROBOTS:

- Limited workspace
- Complex forward kinematics
- Difficult singularity analysis
- Complex mechanical design and control

APPLICATIONS OF PARALLEL ROBOTS:

- High-speed pick-and-place operations
- CNC machining and milling
- Flight and motion simulators
- Medical and surgical robots
- Precision assembly and micromanipulation