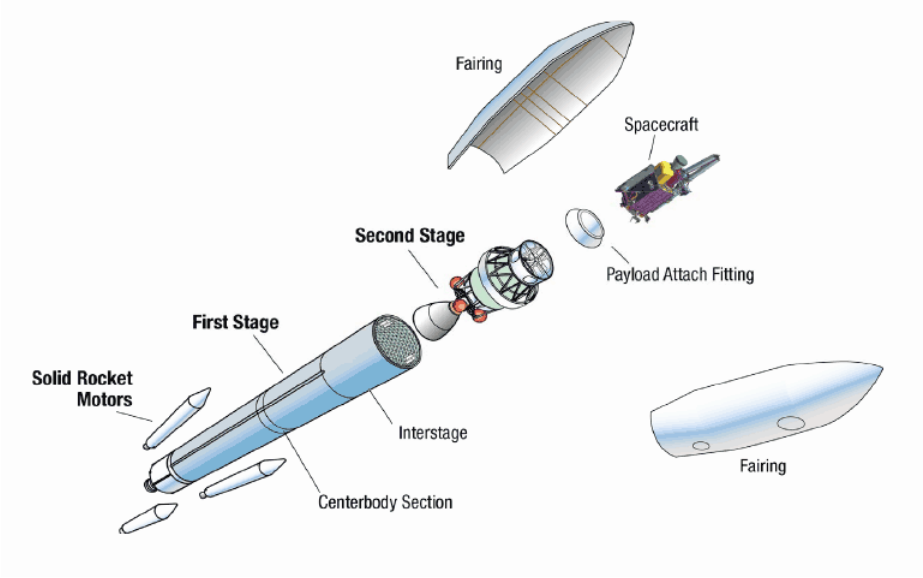
Subject Code & Name**: 23AST101 Fundamentals of Aerospace Engineering**

Topic: Components of Space vehicles and their functions

Space vehicles, including spacecraft and launch vehicles, are complex systems designed for exploration, satellite deployment, and other missions beyond Earth's atmosphere. These vehicles consist of numerous components, each serving specific functions to ensure successful operation in the harsh environment of space. Here are the main components of a space vehicle and their functions:



1. Payload

- **Function:** The payload is the primary mission equipment carried by the space vehicle. It can include satellites, scientific instruments, rovers, crew modules, or cargo for resupply missions.

2. Launch Vehicle

- **Function:** The launch vehicle is responsible for lifting the spacecraft from Earth's surface and placing it into the desired orbit or trajectory. It consists of stages, engines, and support systems for propulsion and control.

3. Spacecraft Bus

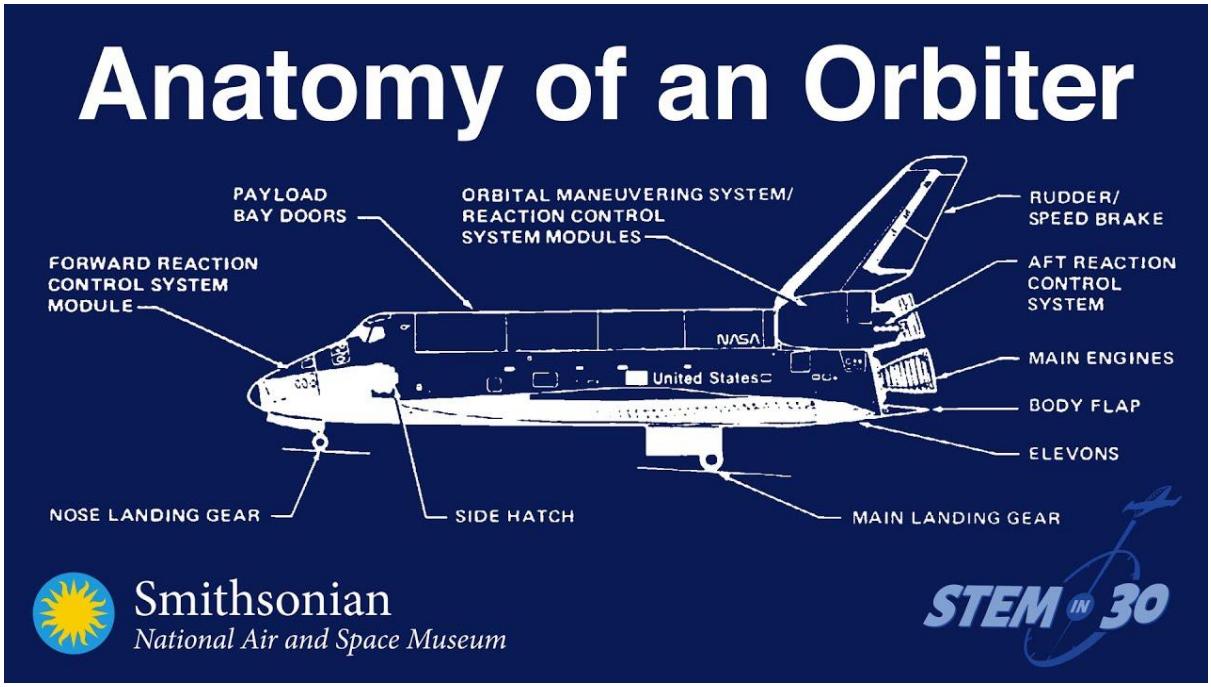
- **Function:** The spacecraft bus provides structural support and houses systems necessary for spacecraft operation, including power, propulsion, thermal control, and communication. It is the platform that supports the payload during the mission.

4. Propulsion System

- **Function:** The propulsion system provides thrust for trajectory adjustments, orbit insertion, and course corrections during spaceflight. It can use various propulsion methods, such as chemical rockets, ion propulsion, or solar sails.

5. Power Generation and Distribution

- **Function:** Power generation systems, such as solar panels or radioisotope thermoelectric generators (RTGs), provide electrical power for spacecraft operation. Power distribution systems distribute power to onboard systems and instruments.



6. Thermal Control System

- **Function:** The thermal control system regulates the temperature of spacecraft components to prevent overheating or freezing in the extreme temperatures of space. It includes radiators, insulation, and heat pipes.

7. Attitude Determination and Control System (ADCS)

- **Function:** ADCS controls the spacecraft's orientation, pointing it in the desired direction for communication, scientific observation, or propulsion burns. It includes sensors (gyroscopes, star trackers), actuators (reaction wheels, thrusters), and control algorithms.

8. Communication System

- **Function:** The communication system enables data transmission between the spacecraft and ground control stations or other spacecraft. It includes antennas, transmitters, receivers, and data processing equipment.

9. Navigation System

- **Function:** The navigation system determines the spacecraft's position and velocity relative to its target or reference points using sensors (GPS, star trackers) and onboard computers.

10. Onboard Computers and Control Software

- **Function:** Onboard computers process data, execute commands, and control spacecraft systems and operations. Control software manages autonomous functions, safety protocols, and mission sequences.

11. Structural Components

- **Function:** Structural components, such as frames, panels, and trusses, provide the framework for the spacecraft and ensure structural integrity during launch and in space.

12. Life Support Systems (for Crewed Vehicles)

- **Function:** Life support systems provide astronauts with oxygen, water, temperature regulation, and waste management capabilities to sustain human life during crewed missions.

13. Cargo Bay (for Cargo Resupply Missions)

- **Function:** Cargo bays store and protect cargo during launch and delivery to the International Space Station (ISS) or other destinations. They may include docking ports or robotic arms for automated or manual cargo transfer.

14. Reentry and Landing Systems (for Crewed Vehicles)

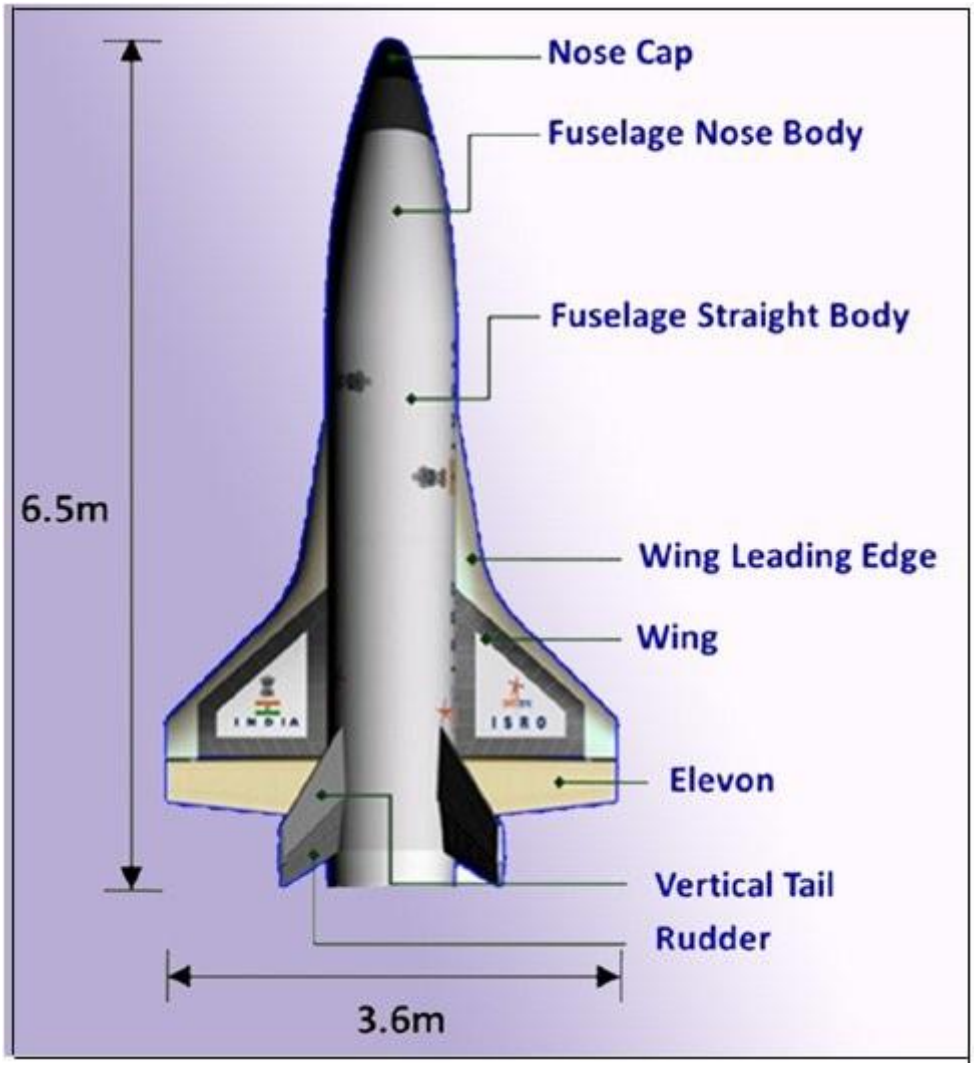
- **Function:** Reentry and landing systems enable crewed spacecraft to safely return to Earth's surface. They include heat shields, parachutes, and landing gear.

15. Environmental Control Systems

- **Function:** Environmental control systems maintain habitable conditions inside crewed spacecraft, controlling temperature, humidity, air quality, and pressure.

Summary

Space vehicles are sophisticated systems comprised of numerous components working together to achieve specific mission objectives. Whether launching satellites, exploring other planets, or conducting scientific research, each component plays a vital role in the success and safety of space missions. Understanding the functions of these components is essential for the design, operation, and maintenance of space vehicles.


Nose Cap
Fuselage Nose Body
Fuselage Straight Body
6.5m
Wing Leading Edge
Wing
Elevon
Vertical Tail
Rudder
3.6m