

## Lecture-1

### Some basic definitions

#### **1. What is Space?**

- (a) Near vacuum outside earth's atmosphere (thin atmospheric envelop up to 100 km).100 km onwards normally it is considered as space.
- (b) The volume in which all the celestial bodies move.

#### **2. What is the difference between kinematics, kinetics and dynamics?**

- (a) Kinematics – The study of motion of body without reference to mass or force (treats only geometrical aspect of motion; e.g. circular motion)
- (b) Kinetics – The branch of dynamics that excludes the study of bodies at rest. Other way it can be defined as the scientific study of the way energy behaves when something moves. Thus, it is analysis of the force causing the motion.
- (c) Dynamics – The branch of mechanics concerned with the forces that (kinematics + kinetics) change or produce the motions of bodies. Also it can be defined as the scientific study of motion, energy and forces (we talk about equilibrium states also).

#### **3. What is mechanics?**

Mechanics is the science of forces and motions.

#### **The study of space flight mechanics can be broadly divided into three categories**

Astronautics/Astro dynamics/ Orbital Mechanics	<u>Space Dynamics</u>		Celestial Mechanics
Study of motion of man-made objects in space subject to both natural and artificially induced forces.  This definition combines features of celestial mechanics with orbital and attitude dynamics	Orbital Mechanics	Attitude Dynamics	Science of motion of heavenly objects
	Also called trajectory dynamics. This deals with the study of motion of spacecrafts (force free motion under gravity for orbital motion), also deals with spacecraft trajectories including orbital maneuver, orbit plane change, interplanetary transfer, and is used to calculate results of propulsive maneuver	This is also called librational dynamics and deals with orientation of an object in space (forces and moments are taken into consideration)	

## **Spacecraft: A vehicle in space**

1. Sputnik I, 200 lbs, October 4, launched 1957 (first satellite, Russian)
2. Explorer, 20 lbs, launched Jan-Feb 1958 (American)
3. Luna-1, first satellite sent to moon, Jan 2, 1959 but escaped into the outer space
4. Luna-2, first to reach the surface of moon, (Sept. 12, 1959)
5. Apollo-8, first to orbit the moon (manned mission, Dec 21, 1968)
6. Apollo-11, first man landing on moon, launched July 16, 1969 and landed on moon on July 20, 1969
7. Aryabhat, ISRO first Indian satellite, launched (April 19, 1975) – From Russia. ISRO becomes govt. organization (April 1, 1975)
8. Bhaskar 1, an experimental satellite for earth observation, launched from Kapustin Yar Russia aboard inter-cosmos launch vehicle (June 7, 1979).
9. SLV-3 (satellite launch vehicle-3) (A four stage vehicle) with Rohini Technology Payload on board (August 10, 1979). Satellite could not be placed in orbit.
10. SLV-3 (Second Experimental Launch, July 18, 1980) Rohini satellite successfully placed in orbit

## **Space Vehicles can be categorized in the following 6(six) categories**

1. Space Carrier Vehicle – e.g. Columbia, Challenger
2. Unmanned Earth Satellite – Unmanned vehicle close to earth
  - (a) Scientific Satellite – (i) study of earth's atmosphere  
(ii) study of biological process etc.  
  
altitude – 100-1000 km.
  - (b) Application Satellite – serves various practical purposes
    - Military
    - Communication - INSAT
    - Remote sensing } IRS
    - Meteorological }

3. Manned Earth Satellite – (& space station) (High reliability required, Reentry required for manned satellite).

4. Orbital Support Vehicle / Satellite: Long life and Big size space station – Saluze, MIR, SKYLAB, Freedom

5. Space Probe: Interplanetary Satellites

6. Spaceship: Takes man from one celestial body to another

### **Geostationary and Geosynchronous satellite**

Geostationary: Remains over one spot on the earth (24 hrs) in equatorial plane

Geosynchronous: A satellite having a period of 24 hrs but does not remain over one spot. Such condition arises when the satellite is in non equatorial plane but in circular orbit which results in a north-south drift. If in elliptical orbit then east-west drift is also present.