Space Research

Space research is scientific studies carried out using scientific equipment in outer space. It includes the use of space technology for a broad spectrum of research disciplines, including Earth science, materials science, biology, medicine, and physics. The term includes scientific payloads everywhere from deep space to low earth orbit. Space science and space exploration involve the study of outer space itself, which is only part of the broader field of space research.

Orbits can be classified on

- **Altitude**
- **Inclination**

Based on Altitude

- Low Earth Orbit (till 2000kms)
- Medium Earth Orbit (2000-36000kms)
- Geo-Synchronous Orbit (36000)
- High Earth Orbit (>36000kms)

Note: All manned missions have taken place in the Low Earth Orbit except the Apollo Program of the NASA.

Karman Line: It is an imaginary line that separates Earth's atmosphere from outer space. This line is at an altitude of 100kms from the Earth's surface.

Based on Inclination

- Inclined orbit
- Not Inclined orbit

Inclined orbits

- **Polar Orbit**
  An orbit, where the satellites either pass close to or pass over the poles. It is at an inclination of 90 ° to the equator.
- **Polar SunSynchronous Orbit (SSO)**
  This orbit is at an inclination of 98 ° to the equator. This orbit is at an altitude of 800kms from Earth's surface. Remote sensing satellites, Weather satellites, Spy satellites will use this orbit.

Not inclined orbits

- **Ecliptical Orbit**
  Ecliptic plane is the apparent path of sun on the celestial sphere as viewed from centre of the Earth.
- **Equatorial Orbit**
  This orbit is parallel to the equator.

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What do you mean by **Synchronous** orbits?

These are orbits where the satellites have the same orbital period as that of the object being orbited. For example, Geo-synchronous orbits are orbits where the satellites orbital period is the same as the Earth's Rotational period.

Geostationary	**SunSynchronous**
• It is in Geosynchronous orbit • Altitude is at 36,000km • It is a circular orbit • It is an Equatorial orbit	• It is in Sun Synchronous orbit • Altitude is at 800km • It is an Elliptical orbit • It is a polar orbit

Satellite systems

The satellite systems can be divided into

- Remote Sensing
- Communication satellites

- **Remote sensing** satellites are those satellites that are used as weather satellites. These are placed at an altitude of 800km. They measure EM radiation that is reflected, scattered from the Earth's surface. India's remote sensing satellites are world's largest constellation of satellites now consisting of 12 satellites.

Applications of Remote Sensing satellites include,

In Agriculture, it is used for Crop forecasting, movement of locusts, flood warning.

In Resources management, it is used to map forest cover, identify forest fires, mineral mapping, National wastelands maps are prepared using this data.

In disaster management, it is used to warn about cyclones, floods and tsunami.

In defence, it is used to identify troop movements.

- **Communication satellites** in India are termed INSAT (Indian National Satellites) series of satellites.

Latest launch of a communication satellite was the GSAT-10. It carried 12 normal C- band transponders, 12 extended C-band transponders and 12 Ku-band transponders.

Applications of INSAT

Telecommunication, Television and also Metereology applications.

Transponders: These are devices that receive signals from the ground station, amplify them and send it back to ground stations.

There are three types of transponders

- S band (2.5Ghz – 2.7Ghz)
- C band (3.9Ghz – 6.24Ghz)

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- Ku band (11Ghz – 14Ghz)

Why equatorial site is preferred for satellite launches?

- For a communication satellite, the satellite is required to be placed in Equatorial belt.
- At the equator, there is considerably less amount of gravity experienced than at any other places

Challenges in building a Cryogenic engine

- Since very low temperatures are involved, the metals at that temperature becomes brittle and new welding techniques and new alloys have to be used.
- Liquid Hydrogen and Liquid Oxygen are to be pumped at the right proportion.
- Storing Liquid Oxygen and Liquid Hydrogen, is difficult.
- The fuels as are factory loaded for PSLV launch can't be done in the case of GSLV launch and the fuel has to loaded only a couple of hours before the launch.

What do you mean by Specific impulse?

It is defined as the amount of thrust provided (1kg) in 1sec. Liquid Propellants has a higher specific impulse than most of the solid propellants.

Future launches

SARAL – Satellite for ARgos and ALtikameter

This is a cooperative altimetry technology mission of Indian Space Research Organisation (ISRO) and CNES (Space Agency of France). The ISRO built satellite with payloads modules (AltiKa altimeter, DORIS, Laser Retroreflector Array (LRA) and ARGOS-3 (Advanced Research and Global Observation Satellite) data collection system provided CNES will be launched by Indian Polar Satellite Launch Vehicle rocket into the Sun-synchronous orbit (SSO). PSLV-CA version will be used for this launch. This satellite was scheduled to be launched in Dec-2012, but now postponed to Feb-2013.

There are 5 other satellites that are scheduled to be launched along with SARAL. These include

Sapphire and Neossat from Canada

Brite and Unibrite from Austria

Aausat from Denmark.