



WB - PSC

Pre & Mains

WEST BENGAL PUBLIC SERVICE COMMISSION

Paper 4 – Volume 2

S&T & Environment



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Space Technology

Space Technology

Q. What are the different kind of minerals present in her Indian Soil?

Q. Coral bleaching?

Why we need to study space technology:

- To enhance the communication system and to monitor marine ecosystem via remote sensing satellite under which oceanography, mine exploration comes and to enhance the navigation system of the earth.

Oceanography

- It is the study of physical and biological aspects of the ocean.

Space

- Space refers to a void or vacuum that exists between the celestial body containing a very low density of particles predominantly the plasma of hydrogen and helium as well as electromagnetic radiations and quit and cosmic rays.

Cosmic rays

- There are the energetic particle which having speed apparently with the speed of light.

Treaties of Space

Outer space treaty of 1967

- Under this treaty we forbids nations from placing weapons or having any military base in the outer space.
- The resources of outer space is common to all the planets.

Rescue Agreement of 1968

- Under this the nations are supposed to joined hands in the rescue of missing space crafts or humans in the outer space.

Moon treaty of 1979

Under this treaty property of moon is a property of earth i.e. for everyone.

Q. Why the size of moon is shrinking day by day which is a very serious concern for earth?

Important land mark in the space history:

In 1957, Sputnik (1st artificial satellite) which was sent in the orbit by Russia.

- After that in 1969 Apollo 11 mission occurred in which 1st man was sent to moon by US.
- In 2000, International space station was located in space with 10-15 crew members with an objective of studying the human physiology and studying about the microorganism.

Reasons to choose Sriharikota as Launching Centre:

1. There is no land mass around.
 2. The area is 10 month rain free area
 3. High calmness in the weather condition
 4. There is no delay launching due to bad weather.
- Indian space program was formulated officially with constitution of Department of Atomic energy in 1979 as Dr. Homi Bhabha was chose to be Chairman of Dept. of Atomic energy.
 - Vikram Sarabhai has initiated research be establishing the physical research lab at Ahmadabad and Indian National Committee for space research with Vikram Sarabhai as Chairman was formulated in 1962.
 - In 1963 Indian 1st Rocket launch center was established at Thumba which is near Thiruvananthapuram and we started with two Russians.
 1. Apache mission
 2. Rohini mission with sounding rockets
 - In 1935, Hot air balloons armed a two man once reached a recorded altitude known as explore it.

Note:-

- What are sounding rockets?
- Brief idea about Apache and Rohini mission.
- 15 August 1969, ISRO was established under the Department of space and ISRO is headquartered in Bangalore and we have 11 sub-center in ISRO which are there in India.

Sub-Center of ISRO

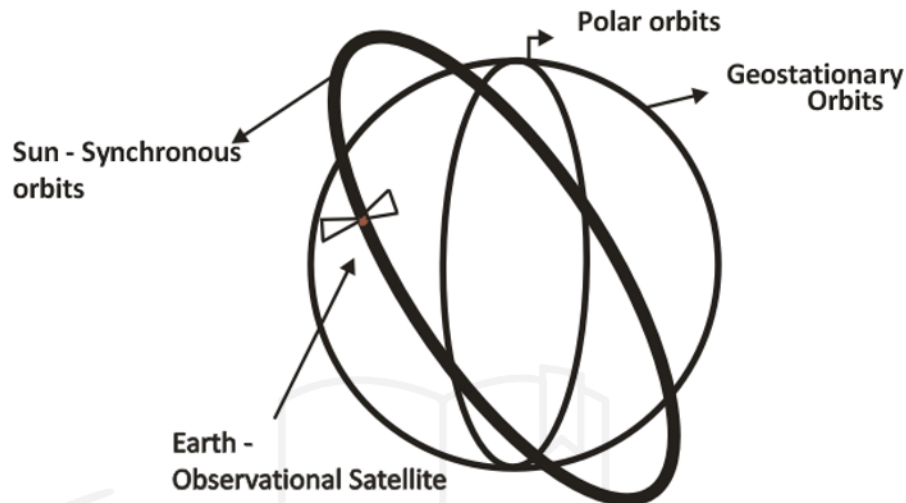
1. **ISAC – ISRO satellite center, headquarter** – Bangalore and it is engaged in developed satellite technology and implementation of scientific and technology aspect related to the satellite technology.
2. **SAC – Space Application center:** It has two headquarters in Ahmadabad and Delhi. It is involved in designing space borne instruments primarily the pay loads which includes communication and metrological pay loads for Indian satellite and optional microwave pay loads.

Pay loads

They are the type of satellite which are placed in the launching vehicle. This satellite can be of our space center or it can be neighboring or other countries also.

1. **ISTRAC** – ISRO technology Tracking and command Network Headquarter is based in Bangalore, Lucknow and Nichobar and here telemetry means there process of recording transmitting the readings of an instrument.
2. **IDSN** – Indian Deep Space Network: Headquarter in Karnataka in the city called Bylala, 40 KM from Bangalore and Commissioned in 2001. It was setup for the deep space mission like or mars orbital mission which were there in 2014. This Deep space Network was commissioned in 2008.
3. **MCF – Master Central Facility:** It is located in Hassin, Karnataka and it has a major function of controlling all the geostationary satellites of ISRO during their initial orbital rising and their payload testing.
4. **Vikram Sarabhai Space Center:** Located in Thumba and it has the primary function of designing and development of launch vehicle from SLV to ASLV and PSLV to GSLV.

- There are generally two types of orbits which are circle orbits and elliptical orbits.
- Circular orbits are those orbits which have the distance from the center and elliptical orbits are having varied distance from the center.



Polar Orbits

Polar orbits are the orbits which are perpendicular to the equator and they are generally North poles and South Poles in this orbit and they are one of the types of elliptical orbits.

Sun-Synchronous Orbits

They are one of the types of polar orbits and they are also called sun synchronous polar orbits and they are inclined at some angle with the polar orbits and they have the nature of shifting their orbits by 1 per day. The Earth observation satellite are placed in sun synchronous orbits and they have direct solar rays from which they receive direct energy source from the solar rays.

Geo-stationary Orbits

- They are the type of the orbits which have the rotation as that of the Earth and same direction as that of the Earth.
- They are generally placed at 36000 KM from the Earth's surface and they are also known as High End Orbits and here the communication satellites are placed in the respective orbits.

Geosynchronous Orbits

- There are the types of Geostationary orbits which have the rotation as that the Earth but not the direction is same as that the earth.
- The direction of the satellites depends on their purpose and it will be directly proportional to their direction.

Note:

- Geosynchronous orbits are the type of geostationary orbits but geostationary orbits are not the type of geosynchronous orbits.

Note:

- Sun-synchronous orbits are the types of polar orbits but polar orbit are not the type of sun synchronous orbits.

Satish Dhawan Space Centre:

- Headquarter in Sriharikota and it is used for launching the satellite into geostationary orbit, Low earth orbit and Polar orbit.

Liquid Propulsion system Centre:

- It is headquarter in Valiamala, Kerala, Mahaendragir, Tamilnadu, Bangalore and it is engaged in development of liquid and cryogenic propulsion stages for launch vehicles and propulsion system.

National Remote Sensing Centre:

- It is headquarter in Hyderabad. It is responsible for data collection, processing of the data and providing the support for the management activities and national resource management.
- Development and Educational Communication Unit:
- It is headquarter in Ahmedabad and it is involved in system definition and socio economic research and evaluation of Satellites based on its application.

ANTRIX

It is a commercial wing of ISRO, under the Department of Space, Which provide services of -

- Transponder Service
- Launch Service

Headquarter in Bangalore

Transponder Service

- There are the services which are 2 way communication that means they send and receives the signals in which Ku and Ka band are primarily used for casting and communication services.

Country	PayLoad
Korea	Kritsat
Germany	Tubsat
USA	Dova, Path Finder
Belgium	Proba
France	Spot 6, Spot 7
Indonesia	Lafar

Satellite:

- It is an any entity that is controlled by another entity by periodic manner.
- Anybody that moves another body in a mathematical predictable path that is called an orbit.

Satellite DNA

- It is the unique entity for each period in the body which helps in rape cases and neculer cases etc.

Swath Value

- Swath value is the value of an area which is being covered by a satellite in its one revolution.

Merits of Satellite

1. Area of coverage is huge which means that only 3 satellite can consume the whole world.
2. The trmsmission cost is independent of the distance covered by the satellite in that coverage area.
3. They have range of function for example broadcasting services are the radio services.

Demerits Of satellite communication

1. Highly cost incentive technology.
2. It space pollution or space debris.
3. There is no damage repair in Satellite and the band width is used up fully in the satellite.

Components of Satellite

1. Bus Modules

It is basically a cubical structure and has a control system which controls the accelerometer and Gyroscopes of the satellite.

2. Solar Panels

This solar panels have photo voltaic cells which give them the energy to revolve around the orbit.

3. Optical imaging cameras/ Spectral cameras

These optional imagers is snap the exact location of the earth with the help definition cameras and these sepral cameras gives the spectral images of the district location objects of the earth.

Low earth orbit

- It is orbit in which any satellite which is placed between 110KM – 2000KM and they have an orbital time period which is less than 24 hrs. which is 90 min. So that means it can across the earth
- More than 20 times in a day and generally the international space station and humble telescope is placed in low Earth orbit.

Medium Earth Orbit

- It is the type of orbit in which we have navigational satellite which have the range of 10000 KM to 20000 KM and it provide coordination of satellites with the help of their position and generally satellite take 12 hrs. to complete one revolution across the orbit.

Types of satellite

Communication Satellite

- These are the types of satellites which helps in communication and it transmits and receives the signals which is the two way communication.
- Therefore the transponder services are used in the communication satellite.

Ex. INSAT – Geostationary Satellite

Remote Sensing Satellite

- These are having active and passive sensing function as they radiation in different wavelength either reflected or emitted by the earth surface in real time.

Active sensing

- It is that type of sensing in which the satellite take its own energy to transmit the waves.

Passive Sensing

- In passive sensing the satellite takes Sun's energy to transmit the wave.
- The payload which are used in remote satellite are as follows.
- Multispectral Scanner depends on wavelength and the swath value of the satellite in the remote sensing parameters.
 - Range – 0.01 μm to 0.02 μm
 - Swath value – 185 KM
 - Wide field sensors

They are always in informed region. Here the mirrors can rotate 30^0 and swath value is 150 KM.

Earth Observational Satellite

- They are types of satellite which are placed in Sun synchronous orbits and also the Low earth orbit.
- They have a basic function of observing the earth and gives the close images of the earth and it also helps in alarming of weather forecasting, Flood management, Tsunami alerts etc.

Types of Launching Vehicle

Satellite Launching Vehicle (1979-1989)

- It is a four stage rockets and all the stages are having solid fuels.
- It has a capacity of launching the satellite which have the weight of 40 KG.
- They are placed in Low earth orbit.
- They were active.
- They were launched to launch the Rohini series of Satellite.

Augmented Satellite Launch Vehicle

- They have 4-5 stage engine to propel the motion.
- Their engines are having soiled fuels in them.
- Their capacity of launching the Satellite up to 150 KG.
- They are also placed in Low Earth orbit.

Polar Satellite Launch Vehicle

- In PSLV the remote sensing Satellite are used and they have 4 stage rocket engine but they have alternate solid and liquid fuels in them.
- They are placed in polar orbits and sun synchronous polar orbits.
- They have average carrying capacity of 1200 KG.

1. PSLV Core alone –

- In this type of launching vehicle they have the carrying capacity of 1000 KG.
- It is placed in Low earth orbit.

2. PSLV Standard

- They have the carrying capacity of 1000 KG in the Low earth orbit and 1150 KG in the Geostationary transfer orbit.

3. PSLV Extra large

- They have the carrying capacity of 1750 KG in the low earth orbit and 1300 KG in the Geostationary transfer orbit.

Geostationary Satellite Launching Vehicle

- This is the expendable launching vehicle designed to carry the satellites weighing 4 tons equivalent to transfer orbit. It is also called geosynchronous satellite launching vehicle.

- It has 2 stage Rocket engines which has sequential form a solid, liquid and cryogenic fuels.
- They are placed in geostationary transfer orbit.

Functional Versions of GSLV

GSLV Mark I

- It has the carrying capacity of 1500 KG to Geostationary transfer orbit.

GSLV Mark II

- Carrying Capacity of 2500 KG to the GTO and they are being powered by cryogenic engines 75.

GSLV Mark III

- It's carrying to 4000 KG to the GTO and them a being powered by cryogenic engine 20(CE 20).

Types of fuels

1. Solid fuels

- Specific impulse: It is type of impulse or force which is the ratio of thrust force to the weight of the fuel.
- Therefore we have higher specific impulse in cryogenic fuels.
- Higher impulse: $C_p > L > S$

1. Merit

- The most commonly used composition of solid fuel is Hydroxyl terminal poly Butanone (HTPB).
- It is a Cost efficient and cheap type of fuel. They were primarily used in SLVs.
- Force is more less (Thrust Force)
- Shelf life is high.
- Transportation of solid fuel is easy and this is more stable fuel during the flight.

2. Demerits

- It has less impulsive force.
- It has greater mean velocity.
- Poor controlling of combustion.

Q. Why the mission were failed of Apache and Rohini series of satellites?

It is because of the poor controlling of combustion rate the solid fuels. As we know, Combustion is a process in which the burning of fuels occurs in the presence of oxygen.

Liquid

- The most commonly used composition in the liquid fuel, unsymmetrical demotic hydro genic.
- The unsymmetrical types of carbon atoms are there in which we have unsymmetrically the chemical reactants from the left hand side and right hand side (Product side).

1. Merits

- It has considerably higher specific impulse with reipuls the solid fuels.
- It has good controlling of combustion rate.
- They were primarily used in Vikas Engine.

2. Demerits

- Their thrust is quite low.
- They are difficult in transportation.
- Their shelf life is less as compared to the solid fuel.
- This is very high which leads to explosion.

Cryogenic fuels

- They are having very high specific impulse.
- They operate at very Low temperature.
- They have the composition of liquid hydrogen.
- The liquid hydrogen operates at -252°C and liquid oxygen operates at -153°C .
- Generally the cryogenic engine 20 are the better cryogenic as they have higher cryogenic power and higher combustion rate.
- GSLV MK III generally use cryogenic 20 in their height.

Indian Space Mission

Q. Indian Society is a blend of Indian Scientific approach and non-scientific approach and there is a high discourse between the scientific approach and non-scientific approach comment your views in regards to this statement.

Topography

- Characteristics of different land form which are present in atmosphere and Earth surface i.e. position of river, Glacier, Mountain etc.

Tomography

- To study of anything.

Experimental satellite developed

Fentosat - < 0.11 kg

Picosat - < 1 kg

Nanosat – 1-10 kg

Microsat – 10-100 kg

Minisat – 100-500 kg

Indian Solar Power Policy

- This was a first phase of solar mission aim to commission 1000 MW of grid connected solar power projects by 2013.
- It was implemented by National Thermal Power Cooperative (NTPC.)

Phase II

- 2014 December onwards i.e. planned to develop move solar power project and earlier it was a target we will be 20 GW solar power capacity on consuming.
- But in 2015 we revised this policy and we made a target of 100 GW by 2022.

PSLV C-44/ KALAMSAT

PSLV C-44 was succenfully injected Microsat R (imaging radar satellite) and KALAMSAT V2 into their decrynated orbit from Sriharikota.

- It is a new variant of PSLV which is called PSLV DL (Launching vehicle)
- It is a very normal configuration which has 6 boosters or strap-on motors in the 1st stage.

- This PSLV C- 44 will serve as a platform for the satellite for the first time for helping the satellite in deploying their solar panels or other tools.
- KALAMSAT is the first satellite to use the fourth stage orbit in order to reduce debris.
- KALAMSAT is a 10 cm cubical communication nanosatellite which weigh about 1.2kg and it is being developed by the students.
- It's lifespan is about 2 months.

Micro SAT R

- Micro SAT R is a 130 kg military imaging satellite which was developed by DRDO and launched by ISRO.
- PSLV C-43/ HYSIS Satellite
- PSLV C-43 has launched first hyperspectral imaging satellite and 30 international co-passenger satellite (payload)
- PSLV C-43 is the core alone version of PSLV without the 6 strap on boosters.
- HYSIS is an earth observation satellite weighing about 3800kg and configured around ISRO's mini satellite 2 which is called (IMS-2) BUS.
- The major of this satellite was to study the Earth surface in the visible region near infrared region and shortwave infrared region.
- It has a mission life of 5 year.
- Being a earth observation satellite they have hyperspectroce images camera in space which can provided well defined images that can help to identify objects on earth far more then the regular optical or remote sensing cameras.
- This technology will be an abled advantage of watching over India from Space force variety of purpose such as defense, agriculture.

PSLV C-42

- It has launched two foreign which are NOVA Satellite and S1-4
- NOVA SAR is a radar satellite which is used for forest mapping, land uses and Ice cover monitoring and disaster.
- S1-4 is a high resolution earth observational satellite used for surveying resources, environmental monitoring, urban management and disaster monitoring.

PSLV C-40/ CARTOSAT 2

- It has successfully launched CARTOSAT series of satellite which Indians 100th satellite along with 30th copanenger satellite.
- These 30 Copanenger satellite include 1 micro and nano satellite and 25 nano satellite from 6 countries namely Canada, France, Finland, Republic of Korea, UK and USA.
- These satellite are launched in 2 orbits which makes the mission a unique mission.
- These CARTOSAT series of satellites are placed in Sun synchronous orbit and these nano satellites are placed in different orbit and these nano satellites are placed in different orbits like earth orbit and Low earth orbit.
- These CARTOSAT satellite are earth observation satellites, which are having a primary objective of providing higher resolution of specific scenic spot images.

Gaganyaan

Indian Space Research Organization (ISRO) is setting up a third launch pad at Sriharikota, Andhra Pradesh to undertake the Gaganyaan manned space flight programme.

- ISRO currently has two launch pads which are already full.
- Third launch pad is being set up for the human space flight.
- It will be ready in time for the mission.
- In addition, ISRO is scouting for location on the western sea coast near Gujarat to set up another launch pad for the Small Satellite Launch Vehicles (SSLV).

Mission Venus

- The Indian Space Research Organization (ISRO) has short-listed 20 space-based experiment proposals for its proposed Venus orbiter mission 'Shukrayaan'.
- It is a mission to study Venus for more than four years.
- Scientific objectives: Investigation of the surface processes and shallow subsurface stratigraphy; and solar wind interaction with Venusian ionosphere, and studying the structure, composition and dynamics of the atmosphere.

- The satellite is planned to be launched onboard GSLV Mk II rocket.
- The proposed orbit is expected to be around 500 x 60,000 km around Venus. This orbit is likely to be reduced gradually, over several months to a lower apoapsis (farthest point).

Mission

- On 22 July 2019, India launched Chandrayaan - 2, its second lunar exploration mission after Chandrayaan-1 from Satish Dhawan Space Centre, Sriharikota.
- It is a lunar orbiter, lander, rover type mission. It is expected to do soft-landing on the Moon on 7 September, 2019.
- Chandrayaan-2 is ISRO's first attempt to land on any extraterrestrial surface.
- Core Objective: To map the location, and abundance of lunar water.
- The project began in 2007 with an agreement between India's space agency ISRO and Russia's ROSCOSMOS for mutual cooperation.

However, the mission was postponed in January 2013 and rescheduled to 2016 as Russia was unable to develop the lander on time.

- Later, after Russia's withdrawal, India decided to develop the lunar mission independently. Finally, on 22 July 2019, GSLV MK III M1 on its first operational flight successfully launched

Chandrayaan - 2

- Once successful, India will become the fourth country to soft-land a spacecraft on the Moon after the USSR, the USA and China. Chandrayaan-2 will make a landing at a site where no earlier mission has gone, near the south pole of the Moon.
- Chandrayaan-2 is a natural sequel to Chandrayaan-1, an Orbiter mission launched in October 2008.
- Chandrayaan-1, ISRO's first exploratory mission to moon, was designed to just orbit the Moon and make observations with instruments on board.
- Chandrayaan-1 operated for 312 days as opposed to the intended two years but the mission achieved 95% of its planned objectives.