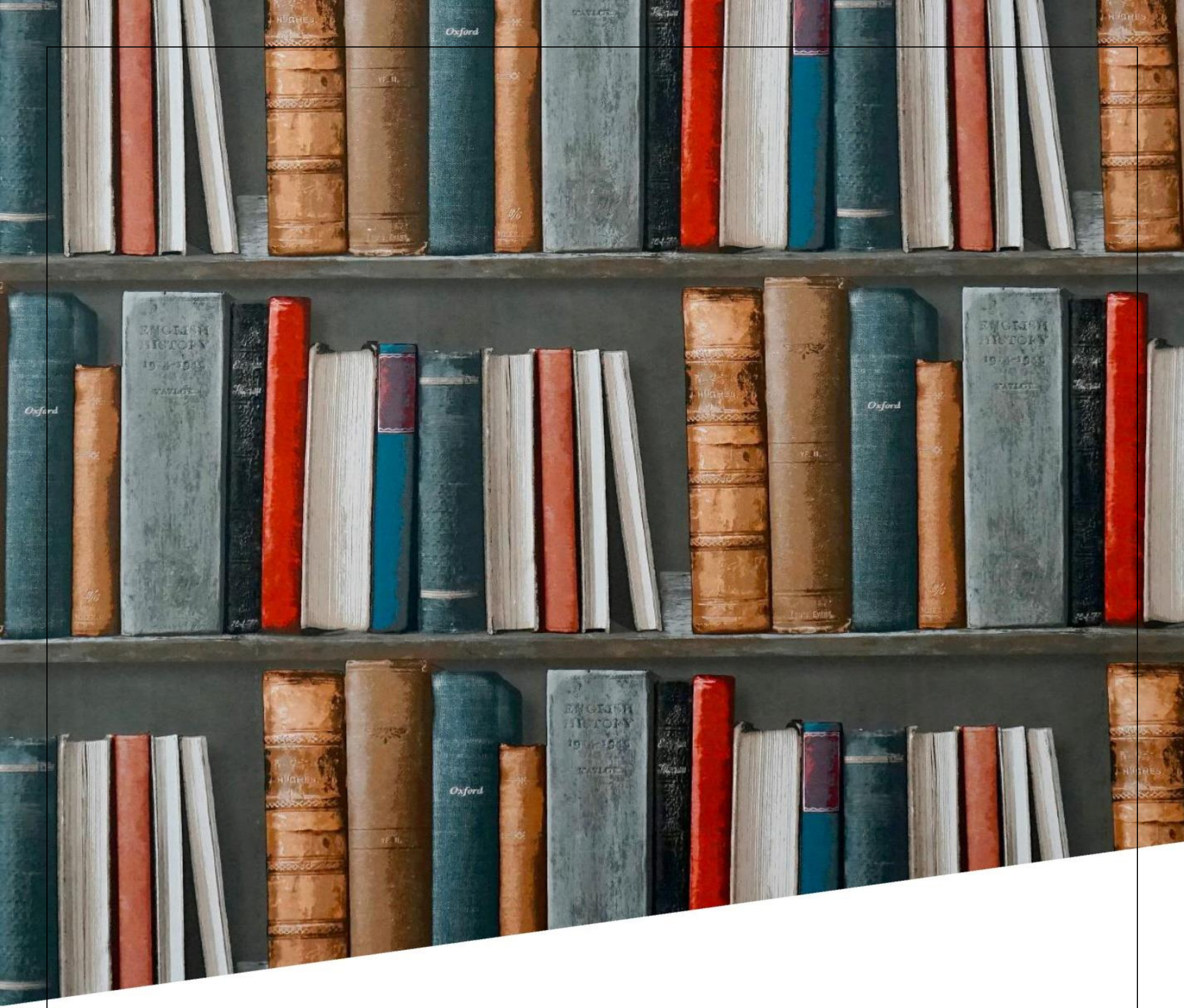

VALUE ADDED NOTES

ILP-2020

IASBABA

Contents

SPACE

India started its space endeavors way before independence in the form of contributions and distinct efforts of scientists like **C.V.Raman and Meghnad Saha.** Initial works were confined to study of radiations, meteorology and study of upper atmosphere. It got boost with the establishment of Department of Atomic Energy (DAE) in 1950 chaired by Homi Bhabha. The department became the sole body to direct funding and look after the research work throughout India.

Another booster was provided by the then PM, Pandit Jawahar Lal Nehru who formed The Indian National Committee for Space Research (INCOSPAR) in 1962 chaired by Dr. Vikram Sarabhai. After seven years the same organization became ISRO in 1969.

- The objectives for which ISRO was set up were to develop space technology and its application for various national tasks.
- One has to grasp the extent to which ISRO has been able to maintain its moral commitment of serving national interest. This is reflected in its consistent experiments and successes of various satellites be it IRNSS or INSAT.
- Majority of ISRO's research work has assisted India's national cause only. It can be better said a National Organization working for national cause before any other endeavors.
- This is unlike other Space Agencies of the world in ISRO's time or some time before; say for example NASA or USSR Space Agencies which rushed towards as competitors fuelling the cold war era.
- The INCOSPAR was initiated under the leadership of Dr. Sarabhai and Dr. Ramanathan. In 1967, the first 'Experimental Satellite Communication Earth Station (ESCES)' located in Ahmedabad was operationalized.
- INCOSPAR set up the Thumba Equatorial Rocket Launching Station (TERLS) in Thiruvananthapuram for upper atmospheric research.
- APPLE was India's first geostationary experimental communication Satellite Project during 1977-83 and was successfully launched by Ariane-1, from Kourou, French Guiana on June 19, 1981.

SATELLITES

Satellites on the basis of its applications and purpose can be divided into four types

- Geostationary Satellites (Communication) - INSAT Series, GSAT series, EDUSAT and HAMSAT
- Earth Observation Satellites- IRS series, CARTOSAT, RESOURCESAT, OCEANSAT and RISAT and recently envisioned ASTROSAT (Astronomy related)
- Navigation Satellites-GAGAN and IRNSS (now NAVIC)
- Space Missions- MOM, Gaganyaan and Chandrayaan-2
- Small Satellites- Jugnoo (Nanosatellite)

ASTRONOMICAL SATELLITES

- These satellites are used for the observation of distant stars and other objects in space. India's **ASTROSAT** is an Astronomical satellite.
- Astronomical satellites are those which are used for observation of distant planets, galaxies, and other outer space objects. Astronomical performance from the Earth's surface is limited by Earth's atmospheric conditions. It makes it even more worse by the filtering and distortion of electromagnetic radiation. This makes it desirable to place astrononomical observation devices into space.
- But space-based astronomy is even more important for frequency ranges which are outside the optic and radio window. For example, X-ray astronomy is nearly impossible when done from the Earth, and has reached its current important stand within astronomy only due to orbiting satellites with X-ray telescopes. Infrared and ultraviolet are also greatly blocked.
- The most famous astronomical satellite is the **Hubble Telescope**. Although now reaching the end of its life it has enabled scientists to see many things that would otherwise not have been possible. Nevertheless it did suffer some major design setbacks that were only discovered once it was in orbit.

ASTROSAT observes universe in the optical, ultraviolet, low and high energy X-ray regions of the electromagnetic spectrum, whereas most other scientific satellites are capable of observing a narrow range of wavelength band.

The scientific objectives of ASTROSAT mission are:

- To understand high energy processes in binary star systems containing neutron stars and black holes
- Estimate magnetic fields of neutron stars
- Study star birth regions and high energy processes in star systems lying beyond our galaxy
- Detect new briefly bright X-ray sources in the sky
- Perform a limited deep field survey of the Universe in the Ultraviolet region

COMMUNICATIONS SATELLITES

- These satellites possibly form the greatest number of satellites that are in orbit. They are used for communicating over large distances. INSAT and GSAT of India comes under this.
- **The Indian National Satellite (INSAT)** systems which are placed in Geo-stationary orbits are one of the largest domestic communication satellite systems in Asia-Pacific region. Established in 1983 with commissioning of INSAT-1B, it initiated a major revolution in India's communications sector and sustained the same later.
- The height of the satellite above the Earth enables the satellites to communicate over vast distances, and thereby overcoming the curvature of the Earth's surface. Even within the communications field there are a number of sub-categories.
- Some satellites are used for point to point telecommunications links, others are used for mobile communications, and there are those used for direct broadcast. There are even some satellites used for mobile phone style communications.
- Even though these satellites did not take the market in the way that was originally expected because terrestrial mobile phone networks spread faster than was originally envisaged, some mobile phone satellite systems still exist.

GSAT-19 satellite with a lift-off mass of 3136 kg, is the communication satellite of India, configured around the ISRO's standard I-3K bus.

- GSAT-19 carries Ka/Ku-band high throughput communication transponders.

- Besides, it carries a **Geostationary Radiation Spectrometer (GRASP) payload** to monitor and study the nature of charged particles and the influence of space radiation on satellites and their electronic components.
- GSAT-19 also features certain advanced spacecraft technologies including miniaturised heat pipe, fibre optic gyro, Micro Electro-Mechanical Systems (MEMS) accelerometer, Ku-band TTC transponder, as well **an indigenous Lithium-ion Battery.**
- GSAT-19 satellite was launched by GSLV Mk III-D1 from the Second Launch Pad (SLP) at Satish Dhawan Space Centre SHAR (SDSC SHAR), Sriharikota.

GSAT-6A, similar to GSAT-6 is a high power **S-band communication satellite** configured around I-2K bus.

- The mission life of spacecraft planned is about 10 years.
- The satellite will also provide a platform for developing technologies such as demonstration of 6 m S-Band Unfurlable Antenna, handheld ground terminals and network management techniques that could be useful in satellite based mobile communication applications
- GSAT-6A was launched by GSLV-F08 , March 29, 2018

GSAT-31- India's telecommunication satellite, GSAT-31 was successfully launched in February 2019 from Kourou launch base, French Guiana by Ariane-5 VA-247.

- This satellite will augment the Ku-band transponder capacity in Geostationary Orbit.

EARTH OBSERVATION SATELLITES

- These satellites are used for observing the earth's surface and as a result they are often termed geographical satellites. India's **IRS and RESOURCESAT** are part of this.
- **Indian Remote Sensing (IRS) satellite system** was commissioned with the launch of IRS-1A, in 1988. With eleven satellites in operation, IRS is the largest civilian remote sensing satellite constellation in the world providing imageries in a variety of spatial resolutions, spectral bands and swaths.

- The data is used for several applications covering agriculture, water resources, urban development, mineral prospecting, environment, forestry, drought and flood forecasting, ocean resources and disaster management.
- Using these satellites it is possible to see many features that are not obvious from the earth's surface, or even at the altitudes at which aircraft fly. Using these earth observation satellites many geographical features have become obvious and they have even been used in mineral search and exploitation.

Cartosat-2 Series Satellite is the primary satellite carried by PSLV-C40.

- This remote sensing satellite is similar in configuration to earlier satellites in the series and is intended to augment data services to the users.
- The imagery sent by satellite will be useful for cartographic applications, urban and rural applications, coastal land use and regulation, utility management like road network monitoring, water distribution, creation of land use maps, change detection to bring out geographical and manmade features and various other Land Information System (LIS) as well as Geographical Information System (GIS) applications.

RESOURCESAT-2A is a Remote Sensing satellite intended for resource monitoring.

- RESOURCESAT-2A is a follow on mission to RESOURCESAT-1 and RESOURCESAT-2, launched in 2003 and 2011 respectively.
- RESOURCESAT-2A is intended to continue the remote sensing data services to global users provided by RESOURCESAT-1 and RESOURCESAT-2

Hyper Spectral Imaging Satellite (HysIS)

- HysIS, the primary satellite of PSLV-C43 mission, weighing about 380 kg, is an earth observation satellite configured around ISRO’s Mini Satellite-2 (IMS-2) bus.
- The primary goal of HysIS is to study the earth’s surface in the visible, near infrared and shortwave infrared regions of the electromagnetic spectrum.

The co-passengers of HysIS include 1 micro and 29 nano satellites from eight different countries including one each from Australia, Canada, Columbia, Finland, Malaysia, Netherlands, Spain and 23 from US.

- The primary goal of HysIS is to study the earth's surface in the visible, near infrared and shortwave infrared regions of the electromagnetic spectrum

RISAT-2B is a radar imaging earth observation satellite developed by ISRO.

NAVIGATION SATELLITES

- In recent years satellites have been used for accurate navigation. The first system known as GPS (Global Positioning System) was set up by the USA and was primarily intended for use as a highly accurate military system. Since then it has been adopted by a huge number of commercial and private users including India.
- India launched its own navigation satellite in the name of IRNSS-Indian Regional Navigation Satellite System.
- The Polar Satellite Launch Vehicle, in its thirty-fifth flight (PSLV-C33), launcheD IRNSS-1G, **the seventh satellite** of the Indian Regional Navigation Satellite System (IRNSS) into a Sub-Geosynchronous Transfer Orbit (Sub-GTO).
- In 2017 all rubidium atomic clocks on board IRNSS-1A failed, rendering the satellite redundant. ISRO's attempt to replace it with IRNSS-1H was unsuccessful when PSLV-C39 mission failed to deploy the satellite on 31 August 2017.
- There are plans to expand NavIC system by increasing constellation size from 7 to 11.

IRNSS-NavIC

- IRNSS is an independent regional navigation satellite system being developed by India.
- It is designed to provide accurate position information service to users in India as well as the region extending up to 1500 km from its boundary, which is its primary service area.
- IRNSS will provide two types of services, namely, Standard Positioning Service (SPS) which is provided to all the users and Restricted Service (RS), which is an encrypted service provided only to the authorized users.

- The IRNSS System is expected to provide a position accuracy of better than 20 m in the primary service area.

Components of IRNSS

- IRNSS comprises of a space segment and a ground segment.
- The IRNSS space segment consists of EIGHT satellites, with three satellites in geostationary orbit and five satellites in inclined geosynchronous orbit.
- IRNSS ground segment is responsible for navigation parameter generation and transmission, satellite control, ranging and integrity monitoring and time keeping.

IRNSS-1I	Apr 12, 2018	1425 kg	PSLV-C41/IRNSS-1I	GSO	Navigation	
IRNSS-1H	Aug 31, 2017		PSLV-C39/IRNSS-1H Mission		Navigation	Launch Unsuccessful
IRNSS-1G	Apr 28, 2016	1425 kg	PSLV-C33/IRNSS-1G	GEO	Navigation	
IRNSS-1F	Mar 10, 2016	1425 kg	PSLV-C32/IRNSS-1F	GEO	Navigation	
IRNSS-1E	Jan 20, 2016	1425 kg	PSLV-C31/IRNSS-1E	GSO	Navigation	
IRNSS-1D	Mar 28, 2015	1425 kg	PSLV-C27/IRNSS-1D	GSO	Navigation	
IRNSS-1C	Oct 16, 2014	1425 kg	PSLV-C26/IRNSS-1C	GEO	Navigation	
IRNSS-1B	Apr 04, 2014	1432 kg	PSLV-C24/IRNSS-1B	GSO	Navigation	
IRNSS-1A	Jul 01, 2013	1425 kg	PSLV-C22/IRNSS-1A	GSO	Navigation	

Applications of IRNSS

- Terrestrial, Aerial and Marine Navigation
- Disaster Management
- Vehicle tracking and fleet management
- Integration with mobile phones

- Precise Timing
- Mapping and Geodetic data capture
- Terrestrial navigation aid for hikers and travelers
- Visual and voice navigation for drivers

Analysis and Importance: International dimensions of Navigation System (More important for Mains- but do remember the names of navigation systems of respective countries)

- The significance of IRNSS cannot be underplayed. Navigation systems, once used by the most powerful militaries around the world, are also being used by civilians through their smart phones.
- In addition, many militaries are using them for a wide range of applications. India's ability to develop its own system without having to rely on any external source will go a long way in securing itself.
- The **US-managed GPS** became available for large-scale use a decade ago or so, although the importance of location precision technologies in the military arena with an emphasis on accumulating hard power has prompted many countries, particularly in Asia, to develop their own versions of GPS and other space-based navigation systems.
- Some of the proven and more popular systems include the **Chinese Beidou, Russian Glonass and Japanese Quazi-Zenith Satellite System (QZSS) t**hat is making slow progress.
- The best known and currently the most widely used navigation satellite system is the **U.S. Global Positioning System (GPS**), which became operational two decades ago.
- **Russia** too offers global coverage with its Global Navigation Satellite System (GLONASS). Europe is establishing its own global system, Galileo. Although the full constellation will be ready only by 2019, it plans to begin some services with a reduced number of satellites by the end of next year.
- **China's Beidou satellite** navigation system, that launched its first navigation satellite in 2000, plans to have a full global coverage by 2020. China has already launched 16 satellites and four experimental ones onto space as part of the Beidou system.
- In spite of the sovereignty and territorial disputes, including recent flare-ups with several Southeast Asian countries, China has been successful in selling its system in many countries in the region.