

ISRO UPSC

ISRO is the world's sixth largest space agency that maintains the remote sensing and communication satellites serving India through research and development institutes, offices, a network of centres, etc.

ISRO functions in different areas, including distance education satellites, telemedicine, cartography, navigation, geographic information system, disaster management, weather forecasting, broadcasting, etc., under the incumbent chairmanship of Shri. S. Somanath.

ISRO History

Let us check out the history of ISRO in this section which will help UPSC aspirants to get a brief overview of this body. In 1962, Jawaharlal Nehru established the Indian National Committee for Space Research under the Department of Atomic Energy. Along with Jawaharlal Nehru, Dr Vikram Sarabhai, the eminent scientist of India, contributed significantly to the development of the INCOSPAR. TERLS, the Thumba Equatorial Rocket Launching Station used to launch rockets, was established by INCOSPAR at Thumba, near Thiruvananthapuram, at the southern tip of the country.

In 1969, INCOSPAR was converted into the Indian Space Research Organisation, but the Department of Space was established in 1972 (Now, ISRO is a part of the Department of Science). The major events in ISRO history are as follows:

- SITE, Satellite Instructional Television Experiment, the largest sociological experiment in the world, was conducted during 1975-76.
- Kheda Communications Project was created in Gujarat. The project worked as a field laboratory.
- Also, Aryabhata, the first Indian Spacecraft, was developed and launched by ISRO using a Soviet launcher.
- SLV-3 had its first successful flight in 1980.
- APPLE came out as the forerunner for Future communication satellite systems.
- The marketing arm of ISRO, Antrix Corporation Limited (ACL), was created to promote and commercialize the exploitation of Space Products.
- ISRO developed a few dedicated centres. These include- the National Remote Sensing Centre (NRSC) in Hyderabad, Space Applications Centre (SAC) in Ahmedabad, Satish Dhawan Space Centre (SDSC-SHAR) in Sriharikota, and Liquid Propulsion Systems Centre (LPSC) and Vikram Sarabhai Space Centre (VSSC) at Thiruvananthapuram.

Major Achievements of ISRO

Since the establishment of ISRO (Indian Space Research Organisation), its workers have been trying hard to achieve its objectives. ISRO has successfully launched the following missions:

Communication Satellites:

Indian National Satellite (INSAT) system, which began operations in 1983 with the commissioning of INSAT-1B, is one of the largest domestic communication satellite systems in the Asia-Pacific region, with nine operational communication satellites in Geostationary orbit launched by the Indian Space Research Organisation (ISRO). It ushered in a big transformation in India's communications market, which it maintained later. Telecommunications, television transmission, satellite newsgathering, societal applications, weather forecasting, disaster

warning, and Search and Rescue operations are all served by the INSAT system. Here are the important communication satellites of ISRO:

Name of the Satellite	Launch Vehicle	Launch Date	Application
EDUSAT	GSLV-F01 / EDUSAT(GSAT-3)	Sep 20, 2004	Communication
GSAT - 8	Ariane-5 VA-202	May 21, 2011	Communication, Navigation
GSAT - 12	PSLV-C17/GSAT-12	Jul 15, 2011	Communication
GSAT - 9	GSLV-F09 / GSAT-9	May 05, 2017	Communication
GSAT - 19	GSLV Mk III-D1/GSAT-19 Mission	Jun 05, 2017	Communication
GSAT - 17	Ariane-5 VA-238	Jun 29, 2017	Communication
GSAT - 6A	GSLV-F08/GSAT-6A Mission	Mar 29, 2018	Communication
GSAT - 29	GSLV Mk III-D2 / GSAT-29 Mission	Nov 14, 2018	Communication
GSAT - 11 Mission	Ariane-5 VA-246	Dec 05, 2018	Communication
GSAT - 7A	GSLV-F11 / GSAT-7A Mission	Dec 19, 2018	Communication
GSAT - 31	Ariane-5 VA-247	Feb 06, 2019	Communication

Earth Observation Satellites:

ISRO has launched several operational remote sensing satellites since IRS-1A in 1988. India now operates one of the world's largest constellations of remote-sensing satellites. To provide necessary data in diversified temporal, spectral, and spatial resolutions, various instruments have been developed and flown onboard to serve different national and international purposes. The data collected by ISRO through these satellites is then used for various applications like disaster management, ocean resources, forestry, environment, mineral prospecting, rural development, urban planning, water resources, and agriculture.

The list of the important Earth observation Satellites of ISRO, along with their launch vehicle and the launch date, is given in the table below:

Name of the Satellite	Launch Vehicle	Launch Date	Application
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Bhaskara-I	C-1 Intercosmos	Jun 07, 1979	Earth Observation, Experimental
Rohini Satellite RS-D1	SLV-3D1	May 31, 1981	Earth Observation
Oceansat (IRS-P4)	PSLV-C2/IRS-P4	May 26, 1999	Earth Observation
The Technology Experiment Satellite (TES)	PSLV-C3 / TES	Oct 22, 2001	Earth Observation
CARTOSAT - 1	PSLV-C6/CARTOSAT-1/HAMSAT	May 05, 2005	Earth Observation
RISAT - 2	PSLV-C12 / RISAT-2	Apr 20, 2009	Earth Observation
Oceansat - 2	PSLV-C14 / OCEANSAT - 2	Sep 23, 2009	Climate & Environment, Disaster Management System
CARTOSAT - 2B	PSLV-C15/CARTOSAT-2B	Jul 12, 2010	Earth Observation
RESOURCESAT-2	PSLV-C16/RESOURCESAT-2	Apr 20, 2011	Earth Observation
Megha - Tropiques	PSLV-C18/Megha-Tropiques	Oct 12, 2011	Climate & Environment, Disaster Management System
RISAT - 1	PSLV-C19/RISAT-1	Apr 26, 2012	Earth Observation
SARAL	PSLV-C20/SARAL	Feb 25, 2013	Climate & Environment, Disaster Management System
CARTOSAT-2 Series Satellite	PSLV-C34 / CARTOSAT-2 Series Satellite	Jun 22, 2016	Earth Observation
INSAT-3DR	GSLV-F05 / INSAT-3DR	Sep 08, 2016	Climate & Environment, Disaster Management System
SCATSAT-1	PSLV-C35 / Cartosat-2 Series Satellite	Sep 26, 2016	Climate & Environment
RESOURCESAT-2A	PSLV-C36 / Cartosat-2 Series Satellite	Dec 07, 2016	Earth Observation

Cartosat-2 Series Satellite	PSLV-C37 / Cartosat-2 Series Satellite	Feb 15, 2017	Earth Observation
Cartosat-2 Series Satellite	PSLV-C38 / Cartosat-2 Series Satellite	Jun 23, 2017	Earth Observation
Cartosat-2 Series Satellite	PSLV-C40/Cartosat-2 Series Satellite Mission	Jan 12, 2018	Earth Observation
HysIS	PSLV-C43 / HysIS Mission	Nov 29, 2018	Earth Observation

Navigation Satellites:

To meet the Civil Aviation requirements, ISRO is working jointly with the Airport Authority of India (AAI) in establishing the GPS Aided Geo Augmented Navigation (GAGAN) system. To meet the user requirements of the positioning, navigation and timing services based on the indigenous system, ISRO is establishing a regional satellite navigation system called Indian Regional Navigation Satellite System (IRNSS).

Experimental Satellites:

ISRO has launched a range of small satellites, mostly for research purposes. This experiment includes remote sensing, atmospheric studies, payload creation, orbit controls, and recovery technology.

A list of the essential experimental satellites launched by ISRO is as under:

Name of the Satellite	Launch vehicle	Launch Date	Application
Aryabhata	PSLV-C40/Cartosat-2 Series Satellite Mission	Apr 19, 1975	Experimental
Rohini Technology Payload (RTP)	PSLV-C16/RESOURCESAT-2	Aug 10, 1979	-
APPLE	Ariane-1(V-3)	Jun 19, 1981	Communication, Experimental
YOUTHSAT	SLV-3E1	Apr 20, 2011	Student Satellite
INS-1C	C-1 Intercosmos	Jan 12, 2018	Experimental

Small Satellites:

Within a short timeframe, the small satellite project will provide a forum for stand-alone payloads for earth imaging and science missions. Two types of buses, the Indian Mini Satellite -1 (IMS-1) and Indian Mini Satellite - 2 (IMS-2) have been designed by ISRO and built to provide a flexible platform for various payloads (IMS-2).

Here is the list of the Small Satellites launched by ISRO:

Name of the Satellite	Launch Vehicle	Launch Date	Application
YOUTHSAT	PSLV-C16/RESOURCESAT-2	Apr 20, 2011	Student Satellite
Microsat	PSLV-C40/Cartosat-2 Series Satellite Mission	Jan 12, 2018	Experimental

Space Science & Exploration Satellites:

Satellites come under this category: AstroSat, the first dedicated Indian astronomy mission to simultaneously study celestial sources in X-ray, optical and UV spectral bands. Mars Orbiter Mission (MOM), the genuinely maiden interplanetary mission of ISRO, launched on November 5, 2013. Chandrayaan-1, India's first mission to the moon, and Chandrayaan-2, the second mission, comprised an Orbiter, Lander and Rover, etc.

Academic Institute Satellites:

ISRO's operations, such as creating connectivity, remote sensing, and astronomy satellites, have affected educational institutions. The launch of Chandrayaan-1 piqued universities' and institutions' interest in developing experimental student satellites.

Here is the table showing the Academic Institute Satellites launched by ISRO:

Satellite Name	Launch Vehicle	Launch Date
ANUSAT	PSLV-C12 / RISAT-2	Apr 20, 2009
STUDSAT	PSLV-C15/CARTOSAT-2B	Jul 12, 2010
Jugnu	PSLV-C18/Megha-Tropiques	Oct 12, 2011
SWAYAM	PSLV-C34 / CARTOSAT-2 Series Satellite	Jun 22, 2016
SATHYABAMASAT	PSLV-C34 / CARTOSAT-2 Series Satellite	Jun 22, 2016
PRATHAM	PSLV-C35 / SCATSAT-1	Sep 26, 2016
Kalamsat-V2	PSLV-C44	Jan 24, 2019

Scramjet (Supersonic Combusting Ramjet) Engine:

In August 2016, ISRO successfully conducted the Scramjet (Supersonic Combusting Ramjet) engine test. The Scramjet engine uses Hydrogen as fuel and Oxygen from the atmospheric air as the oxidizer. The new propulsion system will complement ISRO's reusable launch vehicle with a longer flight duration.

Upcoming Milestones of Indian Space Program

The upcoming missions of ISRO include the following:

- **Chandrayaan-3 Mission:** ISRO will likely launch Chandrayaan-3 Mission in mid-2023 (earlier, it was the third quarter of 2022).

- **Three Earth Observation Satellites (EOSs):** Using the ISRO's workhorse PSLV, EOS-4 (Risat-1A) and EOS-6 (Oceansat-3) will be launched. However, EOS-2 will be launched as SSLV (Small Satellite Launch Vehicle).
- **Shukrayaan Mission:** After successfully launching the Satellite to Mars, ISRO is planning to launch a Satellite to Venus, tentatively named Shukrayaan.
- **Own Space Station:** Joining China, Russia, and the US in the league, ISRO is planning to launch its first space station by 2030.
- **XpoSat:** XpoSat, a Space observatory, is designed by ISRO to study the cosmic X-Rays.
- **Aditya L1 Mission:** The Indian Space Program has a mission to launch a satellite able to go 1.5 million Kms to Lagrangian between Earth and the Sun.

Objectives of ISRO

ISRO hold the vision to harness, sustain and augment space technology for the nation's development and pursue research in space science and planetary exploration. The primary objectives of ISRO are as follows:

- Operational flights of SSLV (Small Satellite Launch Vehicle), GSLV (Geo-synchronous Satellite Launch Vehicle), and PSLV (Polar Satellite Launch Vehicle).
- To design, develop and realize the communication and earth observation satellites.
- Another key objective of ISRO is to design and create new solutions for space transportation.
- To develop navigation satellite systems and the development of satellites for planetary exploration and space science.
- To develop applications for observing the earth more precisely.
- To create a system based on Space for societal applications.
- One of the major objectives of ISRO is to come up with appropriate training, education, and capacity building for students interested in space technology.

About ISRO: Challenges and Opportunities

Though the success stories of ISRO are preached throughout the world, it is facing challenges towards achieving its goals. The challenges and opportunities in front of the Indian Space Programme are as follows:

- Since India is a developing country, it is not in a state that faces certain security and development issues. For example, ISRO becomes questionable and has to justify the allocations for the missions that involve a lot of effort and do not have a direct bearing on development.
- A threat has been elevated by China after the testing of its ASAT, an Anti-satellite missile, in 2007. It can initiate an arms race in Space along with that on land.
- Because India relied on satellites like MOM, there have been military vulnerabilities.
- Though DRDO is developing a missile, it needs the US or other countries as its partners.
- The satellite was launched by China against Sri-lanka and Pakistan in 2011 and 2012.
- The government is more involved in discussing the code of conduct and other important documents with the US and the EU.
- There have been internal disputes in ISRO.