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General Scientific and Technological Development - Space and Nuclear Program of India for SSC & Railway Exams

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General Scientific and Technological Development - Space and Nuclear Program of India

- Indian heritage is one of the richest and oldest in the world. Science and Technology have always been an integral part of Indian culture
- The Department of Science and Technology plays a pivotal role in the promotion of science and technology in the country
- Science and technology play a vital role in the development strategy of various sections of society
- The Department of Scientific and Industrial Research (DSIR) was set up in 1985
- The Council of Scientific and Industrial Research was established by the Government of India in September 1942 as an autonomous body that has emerged as the largest research and development organization in India.

INDIAN SPACE PROGRAMME

- Indian National Committee for Space Research (INCOSPAR) was set up by the Government of India in 1962. INCOSPAR grew and became ISRO in 1969
- Indian Space Research Organisation (ISRO) founded on **15 August 1969** to develop an independent Indian space program. Its headquarters are in **Bangalore**
- In 1972, Government of India had setup a Space Commission and the Department of Space (DOS), bringing ISRO under the Department of Space DOS
- India launched its first low orbit satellite Aryabhata in 1975, for which the launch vehicle was provided by the erstwhile Soviet Union.
- Antrix Corporation The marketing arm of ISRO, Bengaluru
- NewSpace India Limited (NSIL) -- ISRO's commercial arm
- Rohini became the first satellite to be placed in orbit by an Indian-made launch vehicle SLV-3 in 1980
- Ariane Passenger PayLoad Experiment (APPLE) was India's first communication satellite successfully launched in 1981.

ISRO Centres

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Vikram Sarabhai Space Center	Trivandrum
Liquid Propulsion Systems Centre (LPSC)	Thiruvanthapuram
Satish Dhawan Space Centre (SDSC)	Sriharikota
U R Rao Satellite Centre (URSC)	Bengaluru
ISRO Propulsion Complex	Mahendragiri
Space Applications Centre	Ahmedabad
National Remote Sensing Centre	Hyderabad
ISRO Telemetry Tracking and Command	Bengaluru
Network	
ISRO Inertial Systems Unit (IISU)	Thiruvananthapuram
Indian Institute of Remote Sensing (IIRS)	Dehra Dun
Development and Educational Communication	Ahmedabad
Unit	

Launch Vehicles

- Launcher or Launch Vehicles are used to carry spacecraft to space.
- India has two operational launchers:
 - 1. Polar Satellite Launch Vehicle (PSLV)
 - 2. Geosynchronous Satellite Launch Vehicle (GSLV).

Polar Satellite Launch Vehicle (PSLV)

- Polar Satellite Launch Vehicle was developed to launch Low Earth Orbit satellites into Polar and Sun Synchronous Orbits.
- PSLV earned its title 'the Workhorse of ISRO' through consistently delivering various satellites to Low Earth Orbits, particularly the Indian Remote Sensing (IRS) series of satellites
- The maximum number of satellites launched by the PSLV in a single launch is 104, in the PSLV-C37 launch on 15 February 2017

Geosynchronous Satellite Launch Vehicle (GSLV)

Geosynchronous Satellite Launch Vehicle was developed to launch the heavier INSAT class of geosynchronous satellites into orbit.

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- GSLV-Mk III is a launch vehicle capable to launch four-tonne satellites into geosynchronous transfer orbit
 - Geostationary orbit, a circular orbit 35,785 km above Earth's Equator in which a satellite's orbital period is equal to Earth's rotation period of 23 hours and 56 minutes.
 - A Geostationery satellite, appearing fixed above the broadcasting station can however receive these signals and broadcast them back to a wide area on earth. The INSAT group of satellites sent up by India are one such group of Geostationary satellites widely used for telecommunications in India.

SATELLITE PROGRAMMES

• India's first satellite the Aryabhata was launched by the Soviet Union on 19 April 1975 using a Cosmos-3M launch vehicle

The INSAT series

• The Indian National Satellite System (INSAT) is a series of multipurpose geostationary satellites built and launched by ISRO to satisfy the telecommunications, broadcasting, meteorology and search-and-rescue needs of India.

The IRS series

• The Indian Remote Sensing satellites (IRS) are a series of Earth observation satellites, built, launched and maintained by ISRO.

South Asia satellite

- The South Asia Satellite (GSAT-9) is a geosynchronous communications satellite by ISRO for the South Asian Association for Regional Cooperation (SAARC) region
- The satellite was launched on 5 May 2017

IRNSS satellite navigation system (NAVIC)

- IRNSS with an operational name NAVIC is an independent regional navigation satellite system 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 borders

Mars Orbiter Mission (Mangalyaan)

- It is India's first interplanetary mission
- Mangalyaan launched on November 5, 2013, by PSLV-C25 got inserted into Martian orbit on September 24, 2014, in its first attempt

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• India is the first Asian nation to reach Martian orbit and the first nation in the world to do so on its maiden attempt

Lunar Missions of India

S.No	Mission Name	Remarks	
1	Chandrayaan-1	1.	Chandrayaan-1 was India's first mission to
			Moon, was launched successfully on October
			22, 2008, from Sriharikota
		2.	Launch Vehicle: PSLV - C11
		3.	Mylswamy Annadurai – Project Director,
			Chandrayan-1
		4.	ISRO Chairman at the time of launch -G.
			Madhavan Nair
		5.	Government of India approved ISRO's
			proposal for the first Indian Moon Mission,
			called Chandrayaan-1 in November 2003.
2	Chandrayaan-2	1.	Chandrayaan-2 is the second lunar
			exploration mission developed by ISRO
		2.	Launch Vehicle: GSLV Mk-III
		3.	The spacecraft was launched on its mission to
			the Moon from the Satish Dhawan Space
			Centre in Andhra Pradesh on 22 July 2019
		4.	Chairman at the time of launch : K Sivan
		5.	Chandrayaan-2's Rover was a 6-wheeled
			robotic vehicle named as Pragyan, which
			translates to 'wisdom' in Sanskrit.
			Weight: 27 kg
			Electric Power Generation Capability: 50 W
3	Chandrayaan-3	1.	Planned mission
		2.	This Mission is a repeat of Chandrayaan-2
			with lander, rover, and a propulsion module to

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attempt a soft landing of the lunar surface.

Gaganyaan mission

- **Gaganyaan** is an Indian crewed orbital spacecraft intended to be the basis of the Indian Human Spaceflight Programme
- The Gaganyaan spacecraft is being designed able to carry three people.
- Russia will train the Indian astronauts for the Gaganyaan mission
- Launch Vehicle: GSLV Mk-III
- Project Director of Gaganyaan: Shri R Hutton

Other Planned missions

S.No	Mission Name	Remarks	
1	Aditya- L1	1. Aditya- L1 is the India's first solar mission	
		2. It is planned to be launched by the end of 2020	
2	Shukrayaan-1	1. Shukrayaan-1 is a proposed orbiter	
		to Venus by the ISRO to study the	
		surface and atmosphere of Venus.	
3	Mangalyaan -2	1. Mangalyaan-2 is India's second	
		interplanetary mission planned for	
		launch to Mars by the Indian Space	
		Research Organisation (ISRO)	
4	NISAR	1. The NASA-ISRO Synthetic	
		Aperture Radar (NISAR) mission is	
		a joint project between NASA and	
		ISRO	
		2. The satellite will be the first radar	
		imaging satellite to use dual	

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frequencies.

List of Important Mission of ISRO

S.No	Name of the Spacecraft	Launch Vehicle	Launch Date
1	Aryabhata	C-1 Intercosmos	Apr 19, 1975
2	Bhaskara-I	C-1 Intercosmos	Jun 07, 1979
3	Rohini Satellite RS-1	SLV-3E2	Jul 18, 1980
4	EDUSAT	GSLV-F01	Sep 20, 2004
5	CARTOSAT-1	PSLV-C6	May 05, 2005
6	CARTOSAT-2	PSLV-C7	Jan 10, 2007
7	Chandrayaan-1	PSLV-C11	Oct 22, 2008
8	SARAL	PSLV-C20	Feb 25, 2013
9	IRNSS-1A	PSLV-C22	Jul 01, 2013
10	Mars Orbiter Mission	PSLV-C25	Nov 05, 2013
	Spacecraft		
11	IRNSS-1B	PSLV-C24	Apr 04, 2014
12	IRNSS-1C	PSLV-C26	Oct 16, 2014
13	IRNSS-1D	PSLV-C27	Mar 28, 2015
14	IRNSS-1E	PSLV-C31	Jan 20, 2016
15	IRNSS-1F	PSLV-C32	Mar 10, 2016
16	IRNSS-1G	PSLV-C33	Apr 28, 2016
17	IRNSS-1H	PSLV-C39	Aug 31, 2017
18	IRNSS-11	PSLV-C41	Apr 12, 2018
19	GSAT-11 Mission	Ariane-5 VA-246	Dec 05, 2018
20	GSAT-7A	GSLV-F11	Dec 19, 2018
21	Microsat-R	PSLV-C44	Jan 24, 2019
22	GSAT-31	Ariane-5 VA-247	Feb 06, 2019
23	EMISAT	PSLV-C45	Apr 01, 2019
24	RISAT-2B	PSLV-C46	May 22, 2019

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25	Chandrayaan2	GSLV-Mk III - M1	Jul 22, 2019
26	Cartosat-3	PSLV-C47	Nov 27, 2019
27	RISAT-2BR1	PSLV-C48	Dec 11, 2019
28	GSAT-30	Ariane-5 VA-251	Jan 17, 2020
29	EOS-01	PSLV-C49	Nov 07, 2020
30	CMS-01	PSLV-C50	Dec 17, 2020
31	Satish Dhawan SAT	PSLV-	Feb 28, 2021
	(SDSAT) (Student Satellite)	C51/Amazonia-1	
32	UNITYsat (Student	PSLV-	Feb 28, 2021
	Satellite)	C51/Amazonia-1	
33	INSPIREsat-1 (Student	PSLV-C52/EOS-04	Feb 14, 2022
	Satellite)	Mission	

Important points

- Rakesh Sharma, an Indian pilot from Punjab was selected as a 'Cosmonaut' in a joint space program between India and Soviet Russia and become the first Indian to enter into the space on 2nd April, 1984.
- Kalam Sat is the world's smallest satellite weighing only 64 gram. It was built by a team of high school students, led by Rifath Sharook, an 18 year old school student from 'Pallapatti' near Karur, Tamil Nadu. It was launched into the space on 22nd June 2017 by NASA.
- NASA is the most popular space agency whose headquarters is located at Washington, USA. It was established on 1st October 1958.
- Apollo Missions are the most popular missions of NASA. These missions made American Astronauts to land on the Moon.
- Apollo-11 was the first 'Man Landing Mission' to the moon. It landed on the Moon on 20th July 1969. Neil Armstrong was the first man to walk on the surface of the Moon. The members present in the crew during the Man Landing Mission were Neil Armstrong, Buzz Aldrin and Michael Collins.
- Kalpana Chawla was born on 17th March 1962 in Karnal, Punjab. In 1988, she joined the NASA. She was selected to take part in the Colombia Shuttle Mission in 1997 and she became the first Indian women astronaut to go to space. On her second mission on the Colombia Shuttle, she lost her life, when the shuttle broke down.

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• The Indian National Satellite (INSAT) system is one of the largest domestic communication satellite systems in Asia-Pacific region with nine operational communication satellites placed in Geo-stationary orbit.

. GAGAN

- GAGAN is an acronym for GPS Aided GEO Augmented Navigation. It is a Space Based Augmentation System (SBAS) jointly developed by ISRO and AAI to provide the best possible navigational services over Indian FIR (Flight Information Region) with the capability of expanding to neighbouring FIRs.
- GAGAN is a system of satellites and ground stations that provide GPS signal corrections, giving you better position accuracy.

Global navigation satellite system (GNSS)

- Global navigation satellite system (GNSS) is a general term describing any satellite constellation that provides positioning, navigation, and timing (PNT) services on a global or regional basis.
- Global Navigation Satellite Systems (GNSS)
 - o GPS (USA)
 - o BeiDou / BDS (China)
 - Galileo (Europe)
 - o GLONASS (Russia)
 - o IRNSS / NavIC (India)
 - o QZSS (Japan)

NUCLEAR PROGRAM OF INDIA

- The department of atomic energy (DAE) was established on 3 august 1954
- The Department of Atomic Energy is a department directly under the Prime Minister of India with headquarters in Mumbai
- Department of Atomic Energy is engaged in the development of nuclear power technology, applications of radiation technologies in the fields of agriculture, medicine, industry and basic research.
- India's three-stage nuclear power program was formulated by **Homi Bhabha** in**1954** to secure the country's long term energy independence, through the use of uranium and thorium reserves found in the monazite sands of coastal regions of South India.

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- A three stage nuclear energy programme based on closed cycle is the flagship of Indian atomic programme.
 - 1. Stage one aims at developing natural uranium fuelled Pressurized Heavy Water Reactors.
 - 2. The second stage aims for utilizing plutonium-based fuels in fast breeder reactors.
 - 3. The third stage focuses on the development of advanced nuclear power systems for utilization of thorium
- Homi J Bhabha is known as the father of India's nuclear program
- **APSARA** was the first nuclear reactor not only in India but also the whole of Asia. The reactor was designed by the Bhabha Atomic Research Center (BARC) and built with assistance from the **United Kingdom**
- Nuclear power is currently the fourth-largest source of electricity in India after thermal, hydroelectric and renewable sources of electricity
- Tarapur Atomic Power Plant-1 (TAPS-1) is the first Nuclear Power Station in India.
- Nuclear Power Corporation of India Limited (NPCIL) is presently operating 22 commercial nuclear power reactors with an installed capacity of 6780 MW
- List of nuclear power station in India

Nuclear power station	State
Kaiga	Karnataka
Kakrapar	Gujarat
Kudankulam	Tamil Nadu
Madras (Kalpakkam)	Tamil Nadu
Narora	Uttar Pradesh
Rajasthan	Rajasthan
Tarapur	Maharashtra

BARC research reactors

- Apsara, Apsara-U, Cirus, Dhruva, Zerlina, Purnima-I, Purnima-II, Purnima-III, and AHWR-CF.
- The Apsara Reactor was permanently shut down in 2010.

KAMINI

• Kamini is a research reactor at Indira Gandhi Center for Atomic Research in Kalpakkam, India.

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• KAMINI was the first and is currently the only reactor in the world designed specifically to use Uranium-233 fuel.

Radiation Technologies & Applications

Nuclear Agriculture

• The nuclear agriculture program of BARC covers the development of high yielding crop seeds using nuclear techniques, fertilizer, and pesticide-related studies, radiation processing of food items, and other areas.

Research Reactors

• The research reactor APSARA, CIRRUS, and DHRUVA at **Trombay** are utilized for basic and applied research, isotope production, material testing, and training for human resource development.

Radioisotope Production

• India is a leading producer of radioisotopes in the world. Radioisotopes are produced in the research reactors at Trombay, atomic power reactors at various places in the country and cyclotron at Kolkata

Nuclear Medicine and Health Care

- Nuclear medicine is an integral part of modern healthcare.
- Radioisotopes and their formulations find wide application in diagnosis, therapy, and health care.

Indian Science Congress Association

- Indian Science Congress Association (ISCA) is a premier scientific organisation of India with headquarters at Kolkata, West Bengal. The association started in the year 1914 in Kolkata and it meets annually in the first week of January
- The latest and 107th Indian Science Congress (ISC) was inaugurated by Prime Minister Shri.**Narendra Modi** on January 3, 2020, at the University of Agricultural Sciences in Bengaluru.
- The 107th Indian Science Congress theme is "Science and Technology: Rural Development"

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