

Science and Technology Class 03

9th July, 2023 at 9:00 AM

DISCUSSION ON QUESTION (09:07 AM)

Question: Discuss the achievements of ISRO in Space Science and Technology. How does space technology contribute to the socio-economic development of the country?

- **Approach:**

- Introduce by writing about ISRO.
- In the body mention the achievements of ISRO:
- Different types of launch vehicles and missions like Chandrayaan, MoM, etc.
- In the socio-economic aspect mention how Space technology helps in
- Weather Prediction
- Disaster management
- Education and Health

NISAR MISSION (09:22 AM)

- It is a collaboration between **NASA and ISRO**.
- It is a remote sensing satellite that will use synthetic aperture radar to produce fine-resolution images of the earth's surface.
- This satellite will make observations in **L-Band and S-band**
- L band will be provided by NASA along with a GPS device along with high capacity solid-state recorder to store data.
- ISRO will provide S-band and GSLV Launch system. This satellite can map Earth with very high resolution and can penetrate clouds and darkness to collect data in any weather.
- It aims to develop our understanding of disasters such as **earthquakes, Tsunamis, volcanoes, and landslides**, as well as environmental monitoring such as glacial melt, forest fires, ice sheet collapse, etc.

ROCKETS OF ISRO 9.33 AM

- Past launch vehicles were **SLV (Satellite Launch Vehicle) and ASLV (Augmented SLV)**
- Presently ISRO uses PSLV (Polar SLV), GSLV Mk II (Geosynchronous SLV), LVM3 or GSLV Mk3, and SSLV (Small SLV)
- Future launch vehicles of ISRO are NGLV, Reusable Launch Vehicle (Next Generation Launch Vehicle), and Scramjet
- **Major components of Rockets:**
- Fuel (Propellant):
- **Solid Propellant:** These are cheaper, simpler, and safer to store and transport.
- However, for solid fuel, once the combustion starts it cannot be controlled or stopped.
- Only when the fuel is exhausted combustion stops and the engine shutdowns.
- E.g. Hydroxy terminated polybutadiene
- **Liquid propellant:** The flow of fuel to the engine can be controlled and thus the thrust.
- The fuel flow to the engine can be controlled, and hence the resulting thrust
- However, liquid fuels require separate storage and transportation mechanism because of safety requirements which also makes them expensive.
- ISRO has developed an indigenous VIKAS engine to operate liquid fuel
- For example, Mono Methyl Hydrazine and a Mix of nitrogen oxides; Unsymmetric Dimethyl Hydrazine and H₂O₂

- **Other Parts:**
- Oxidizer
- Engine
- Control and command system
- Payload box

POLAR SATELLITE LAUNCH VEHICLE (PSLV) (09:59 AM)

- It is the world's one of the most reliable rockets. It has four stages which alternate between solid and liquid fuel.
- Rockets are launched into stages to effectively utilize both solid and liquid fuel as well as to have more control in rocket launches.

Parameters	PSLV	GSLV-MkII	LVM-3	SSLV
Stages	Four stages (Solid-liquid-solid-liquid)	Three stages (Solid-liquid-cryogenic)	Three stages (Solid-liquid-cryogenic)	Three stages (all three solid) with a final liquid velocity trimming module
Capacity	1425 in GTO 1750 in LEO	2250kg in GTO 6000kg in LEO	4000 kg in GTO 8000 kg in LEO	500kg in 500km orbit
Main Applications	For earth observation satellite.	For communication satellites in GTO	Heavier launches in GTO or LEO	Cost-effective launch Can be assembled and launched on demand
Some Important Points	Chandrayan 1, Mars orbiter mission, IRNSS. It has a success rate of greater than 96 percent.	NVS01	Chandrayaan 2 Chandrayaan 3 Gaganyaan It has launched 36 satellites of one web approx weight 6,000 kg together.	Only used twice. The first launch was unsuccessful

CRYOGENIC (10:33 AM)

- Both **GSLV MK II** and **LVM-3** use the cryogenic stage in their final stage
- A cryogenic rocket engine uses cryogenic fuel or oxidizers or both at very low temperature such that fuel and oxidizers which exists in the gaseous stage at room temperature are stored in the liquid stage.
- **Example: Liquid Hydrogen and Liquid Oxygen.**
- However, it provides more thrust compared to a typical solid or liquid fuel.
- Such a stage is very complex because of extremely low-temperature requirements and the associated thermal and structural problems

NEXT GENERATION LAUNCH VEHICLE (11:05 AM)

- ISRO is working to develop a rocket with a capacity of 10,000 kg in GTO and 20,000 kg in LEO.
- This launch vehicle will also have a reusable variant.
- However, for the **reusable variant**, the capacity will be less

ISRO IN SPACE SCIENCES (11:22 AM)

- **Past Missions:**

- Some earlier missions were Chandrayan-1, Astrosat, MOM (Mars Orbiter Mission), and Chandrayan-2.
- Chandrayan-2 achieve limited success as the mission was successful in placing the orbiter, but the other part of the mission i.e. lander and rover failed as soft-landing was not achieved
- ISRO became the first agency to reach Mars in its first mission.
- Astrosat is an astronomical observatory to study distant stars and galaxies.
- Some future missions of ISRO include Chandrayan-3, Gaganyaan, Aditya-L1, Xposat mission, etc.
- Future planetary missions of ISRO are MOM-2, Shukrayan, Space Station, etc.

GAGANYAAN MISSION (11:45 AM)

- ISRO is venturing into a **manned space mission** for the first time.
- The plan is to send a group of 2-3 astronauts in low earth orbit for 5-7 days.
- Even before the manned mission, two other missions will be launched: one unmanned and another with an AI Robot called Vyommitra.
- The government has allocated a budget of 10,000 crore rupees for this mission.
- **Challenges:**
- In the Gaganyaan mission, the first set of challenges will occur during the launch itself.
- In launch, a huge amount of heat will be generated by the rocket.
- Only when all three stages of LVM3 have been separated and the orbital module has been placed into the desirable orbit, one part of the mission will be successful.
- **Surviving in space** with a limited amount of food, water, oxygen, microgravity conditions, weightlessness, and no protection from cosmic radiation, are the second set of challenges.
- **Reentry into the atmosphere** and safe recovery of astronauts requires utmost precision a simple error can end in a disaster.
- There is always a debate about the **need for such costly missions** versus social sector expenditure in India.
- **Benefits of Gaganyaan:**
- ISRO aims to become a player in **space tourism** a successful Gaganyaan mission is a key to that.
- ISRO aims to make a **space station** of its own.
- Gaganyaan will be a stepping stone to that plan.
- Space research can lead to many spinoff applications.
- E.g. Many technologies such as robotic surgery, laser surgery, some techniques of sewage water treatment, food processing, and MRI Scans, among many others are the result of research in space sciences and astronomy.
- The government has allowed **private sector participation** in space.
- Thus more economic and employment opportunities will emerge in the space sector.
- The increased soft power of India.
- Gaganyaan's mission will inspire the younger generation to pursue science and astronomy.

The topic for the next class: Atomic Structure