Shukrayaan I

Prelims: Robotic missions (DaVinci Plus and Veritas) to Venus, Previous Missions Sent on Venus, Important Highlights of Venus.

Mains: ISRO Space Mission to Venus, Space Technology.

Why in News?

Indian Space Research Organisation's (ISRO) Venus mission, Shukrayaan I may be postponed to 2031. ISRO's Venus mission was expected to be launched in December 2024.

- Both the U.S. and the European space agencies have **Venus missions planned for 2031 — VERITAS and EnVision, respectively —** while China may launch around 2026 or 2027.

What Causes the Delay?

- ISRO had originally planned to launch Shukrayaan I in mid-2023 but the pandemic pushed the date to December 2024.
    - Other ISRO missions, **including Aditya L1 and Chandrayaan III**, have also been affected by manufacturing delays and commercial launch commitments.
- Optimal launch windows from Earth to Venus occur once around every 19 months. This is why ISRO has 'backup' launch dates in 2026 and 2028 **should it miss the 2024 opportunity.**
- But even more optimal windows, which further **reduce the amount of fuel required at liftoff, come around every eight years.**
- Right now **the 2031 window is considered very good** by the experts.
- The mission is also **"waiting for formal approval and money"**, which are required before spacecraft assembly and testing.

What is Shukrayaan I Mission?

- **About:**
    - Shukrayaan I will be **an Orbiter Mission.** Its scientific payloads **currently include a high-resolution** Synthetic Aperture Radar (SAR) and a ground-penetrating radar.
        - **SAR** would examine Venus' surface, despite the clouds around the planet, which lowers visibility.
        - It refers to **a technique for producing high-resolution images.** Because of the precision, the radar can penetrate clouds and darkness, which means that it can collect data day and night in any weather.
    - The mission is expected to **study Venus's geological and volcanic activity,** emissions on the ground, wind speed, cloud cover, and other planetary characteristics from an elliptical orbit.
    - Shukrayaan-I will be launched on either GSLV Mk II or **GSLV Mk III,** the latter allows more instruments or fuel to be carried, according to ISRO.
- **Objectives:**

    - Investigation of surface process and **shallow subsurface stratigraphy.** Until now, no prior observation of the sub-surface of Venus has been done.
        - Stratigraphy is a branch of geology in which rock layers and layering are studied.
    - Study of the structure, composition and dynamics of the atmosphere.
    - Investigation of Solar wind **interaction with Venusian** ionosphere.
- **Significance:**
    - It will help to learn how Earth-like planets evolve and what conditions exist on **Earth-sized** exoplanets (Planets that orbit a star other than our sun).
    - It will help in modelling Earth's climate and serves as a cautionary tale on how dramatically a planet's climate can change.

Previous Missions Sent on Venus			
US	**Russia**	**Japan**	**Europe**
▪ Mariner series 1962-1974, ▪ Pioneer Venus 1 and Pioneer Venus 2 in 1978, ▪ Magellan in 1989.	▪ Venera series of space crafts 1967-1983, ▪ Vegas 1 and 2 in 1985.	▪ Akatsuki in 2015.	▪ Venus Express in 2005.

What is Venus?

- It is named after the **Roman goddess of love and beauty.** It is the second planet from the Sun and sixth in the solar system in size and mass.
- It is the **second brightest natural object in the night sky after the Moon.**
- Unlike the other planets in our solar system, **Venus and Uranus spin clockwise on their axis.**
- It is the hottest planet in the solar system because of the high concentration of carbon dioxide which works to produce **an intense** greenhouse effect.
- A day on Venus is longer than a year. It takes Venus longer to rotate once on its axis than to complete one orbit of the Sun.
    - That's 243 Earth days to rotate once - the longest rotation of any planet in the Solar System - and only 224.7 Earth days to complete one orbit of the Sun.
- Venus has been called **Earth's twin because of the similarities in their masses**, sizes, and densities and their similar relative locations in the solar system.
    - No planet approaches closer to Earth than Venus; at its nearest it is the closest large body to Earth other than the Moon.
    - Venus has 90 times the atmospheric pressure of Earth.

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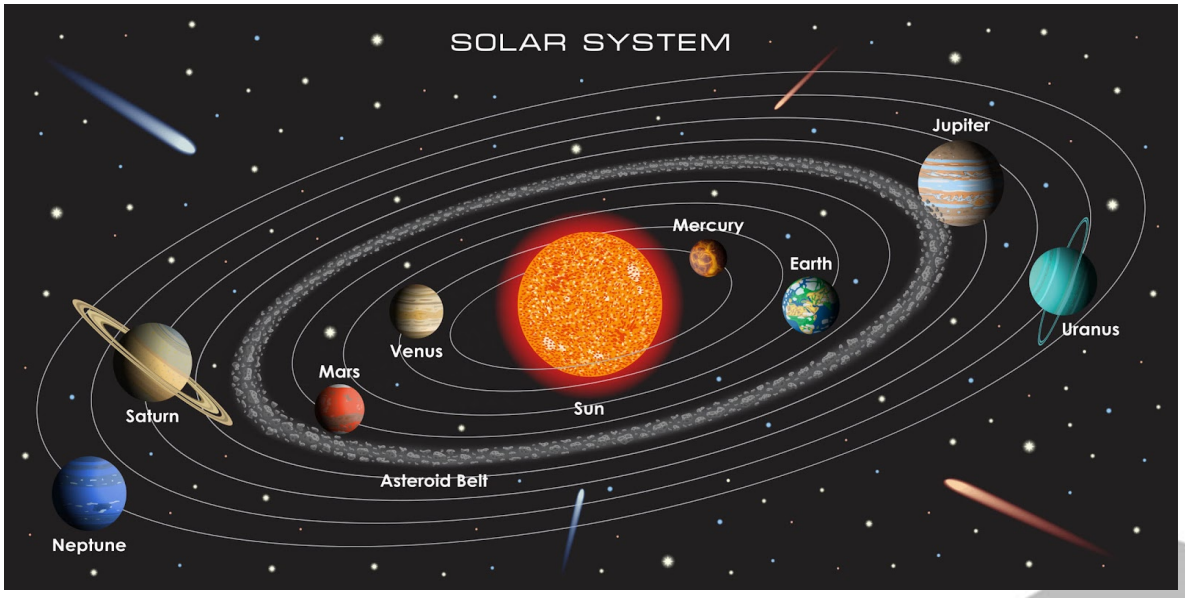

UPSC Civil Services Examination Previous Year Question (PYQ)

Q1. Which of the following pairs is/are correctly matched? (2014)

Spacecraft Purpose

1. Cassini-Huygens: Orbiting the Venus and transmitting data to the Earth
2. Messenger: Mapping and investigating the Mercury
3. Voyager 1 and 2: Exploring the outer solar system

Select the correct answer using the code given below:

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (b)

Exp:

- Cassini-Huygens was sent to study Saturn and its moons. It was a joint collaboration between NASA and European Space Agency. It was launched in 1997 and entered Saturn's orbit in 2004. The mission ended in 2017. Hence, pair 1 is not correctly matched.
- Messenger, a spacecraft by NASA was sent to map and investigate Mercury. It was launched in 2004 and entered Mercury's orbit in 2011. The mission ended in 2015. Hence, pair 2 is correctly matched.
- Voyager 1 and 2 were launched by NASA in 1977 to explore the outer solar system. Both the spacecrafts are still operational. Hence, pair 3 is correctly matched.
- **Therefore, option (b) is the correct answer.**

Q2. Consider the following statements: (2016)

The Mangalyaan launched by ISRO

1. is also called the Mars Orbiter Mission
2. made India the second country to have a spacecraft orbit the Mars after USA
3. made India the only country to be successful in making its spacecraft orbit the Mars in its very first attempt

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (c)

Source: TH