India's Mars Orbiter (Mangalyaan) Mission

The ISRO's (Indian Space Research Organization) prestigious maiden interplanetary mission to Mars, **Mars Orbiter Mission**, got off to a flying start on 5th of November 2013 from the Satish Dhawan Space Centre at Sriharikota at 2.38 pm. The launch vehicle - PSLV-C25 successfully injected the Spacecraft into an Elliptical Parking Orbit around earth. It was a near perfect launch for the Mangalyan spacecraft, the 25th successful mission carried out by the PSLV rocket, the trusted workhorse of ISRO.

The spacecraft first going into orbit around the earth signalled the start of its 300-day voyage to the Red Planet. If everything goes well during this complex and challenging journey through deep space, it will be put into the Mars orbit on September 24, 2014. The orbiter weighs about 1,350 kg and will carry five instruments to conduct a battery of remote-sensing experiments on the availability of methane on the Red Planet, its upper atmosphere, its surface features, mineralogy and so on.

One of the main objectives of the first Indian mission to Mars is to develop the technologies required for design, planning, management and operations of an interplanetary mission. From **technological viewpoint**, ISRO is looking at the mission that would help in design and realisation of a Mars orbiter with a capability to survive and perform Earth bound manoeuvres, cruise phase of 300 days, Mars orbit insertion / capture, and on-orbit phase around Mars. It will also explore possibilities of deep space communication, navigation, mission planning and management and incorporate autonomous features to handle contingency situations.The **scientific objectives** which ISRO intends to achieve is the exploration of Mars surface features, morphology, mineralogy and Martian atmosphere.

Mission Plan

- November 5: PSLV puts spacecraft into an elliptical orbit, 250 km at its closest to Earth and 23,500 km at its farthest.
- Spacecraft's onboard engine fires five times in the coming days, increasing velocity and lengthening the elliptical orbit.
- December 01 2013 - Departure for Mars: The engine fires for the sixth time, accelerating the spacecraft beyond Earth's escape velocity of 11.2 Km/second
- After a journey of almost 300 days and covering 680 million km, the spacecraft will reach its destination.
- September 24, 2014 – Arrival at Mars: Spacecraft's engine fires to reduce velocity and put it into an elliptical orbit, 365 km at its closest to Mars and 80,000 km at its farthest.

Science Instruments

- Methane Sensor for Mars: Look for Methane in the Martian atmosphere. The presence of this gas might be an indicator of life on the planet.
- Lyman Alpha Photometer: Measures relative abundance of two isotopes of hydrogen in order to understand processed by which Mars has been losing its atmosphere, thereby turning from a wet planet to a dry one.
- Mars Exospheric Neutral Composition Analyser: Analyse neutral gas atom found in the outermost part of the Martian atmosphere.
- Thermal Infrared Imaging Spectrometer: Map the surface temperature and infer the composition and mineralogy of Mars.
- Mars Colour Camera: Provide images of Martian surface features and weather events, such as dust storms. It could also supply images of Mars' two moons, Phobos & Deimos.

Sharing Scientific Objectives

The Indian spacecraft shares some scientific objectives with America's Mars Atmosphere and Volatile Evolution mission (Maven), which will be launched in a short time after the launch of India's mission. Sensors on both spacecraft will examine processes that have drastically thinned the Martian atmosphere, which was once thick enough to allow substantial bodies of liquid water to exist on the planet's surface. There had been some preliminary discussions with the Indian science team, according to Bruce Jakosky of the University of Colorado in the U.S., who is MAVEN's principal investigator.

The Indian orbiter will have a useful life of at least six months around Mars. Once the mission is complete, the spacecraft would not be allowed to crash on the planet. There would be enough propellant to take the probe away from the Martian environment. According to the ISRO Chairman Dr. K. Radhakrishnan, globally, there have been 51 missions to Mars till date now. Out of these only 21 have been successful. This is enough indication of the complexity of such missions. Soon after the spacecraft was put into space, action in the Mars orbiter mission shifted to Bangalore based tracking centre, ISTRAC (ISRO Telemetry, Tracking and Command Network).

Of all the planets in the solar system, Mars has sparked the greatest human interest. The conditions in Mars are believed to be hospitable since the planet is similar to Earth in many ways. For ages, humans have been speculating about life on Mars. However, the question that is to be still answered is whether Mars has a biosphere or ever had an environment in which life could have evolved and sustained.

	Mars	Earth
Atmosphere (composition)	Carbon dioxide (95.32%) Nitrogen (2.7%) Argon (1.6%) Oxygen (0.13%) Water vapour (0.03%) Nitric oxide (0.01%)	Nitrogen (77%) Oxygen (21%) Argon (1%) Carbon dioxide (0.038%) Water vapour (1%)
Atmosphere (pressure)	7.5 millibars (average)	1,013 millibars (at sea level)
Deepest Canyon	Valles Marineris 7 km deep 4,000 km wide	Grand Canyon 1.8 km deep 400 km long
Distance from Sun (average)	227,936,637 kilometers	149,597,891 kilometers
Equatorial Radius	3,397 kilometers	6,378 kilometers
Gravity	0.375 that of Earth	2.66 times that of Mars
Largest Volcano	Olympus Mons 26 km high 602 km in diameter	Mauna Loa (Hawaii) 10.1 km high 121 km in diameter
Length of Day	24 hours, 37 minutes	Just slightly under 24 hours
Length of Year	687 Earth days	365 days
Polar Caps	Covered with a mixture of carbon dioxide ice and water ice	Permanently covered with water ice
Surface Temperature (average)	-63 degrees C	14 degrees C
Tilt of Axis	25 degrees	23.45 degrees
Number of Satellites	2 (Phobos and Deimos)	1 (Moon)

****