Hypersonic Technology Demonstrator Vehicle

Why in News

Recently, the Defence Research and Development Organisation **(DRDO)** successfully flight tested the **Hypersonic Technology Demonstrator Vehicle (HSTDV).**

Key Points

- **About:** HSTDV is an unmanned scramjet demonstration aircraft that can travel at **hypersonic speed.**
    - It uses **hypersonic air-breathing scramjet technology.**
    - The vehicle travelled its desired flight path at a velocity of six times the speed of sound i.e. **Mach 6.**
        - **Mach number:** It describes an aircraft's speed compared with the speed of sound in air, with **Mach 1 equating to the speed of sound i.e. 343 metre per second.**

Air Breathing Engine

- Air-breathing engines use oxygen from the atmosphere in the combustion of fuel. They include the **turbojet, turboprop, ramjet, and pulse-jet.**
- This system is **lighter, efficient and cost-effective** than other systems in use.
- Worldwide efforts are on to develop the technology for **air breathing engines for satellite launch vehicles.**
    - Presently, satellites are launched into orbit by multi-staged **satellite launch vehicles** that can be used only once (expendable). These launch vehicles carry oxidiser along with the fuel for combustion to produce thrust.
    - A **propulsion system which can utilise the atmospheric oxygen** during their flight will considerably reduce the total propellant required to place a satellite in orbit.
    - If those vehicles are made **reusable,** the cost of launching satellites will further come down significantly.
- **Types of Air Breathing engines**
    - **Ramjet:** A ramjet is a form of air-breathing jet engine that uses the vehicle's forward motion to compress incoming air for combustion without a rotating compressor.
        - Ramjets work most efficiently at **supersonic speeds** but they are **not efficient at hypersonic speeds.**
    - **Scramjet:** A scramjet engine is an improvement over the ramjet engine as it efficiently operates at **hypersonic speeds** and allows **supersonic combustion.**
    - **Dual Mode Ramjet (DMRJ) :** A dual mode ramjet (DMRJ) is a type of jet engine where a **ramjet transforms into a scramjet over Mach 4-8 range,** which means it can efficiently operate both in **subsonic and supersonic combustion modes.**

Speed Range	Mach Number	Velocity in m/s
Subsonic	< 0.8	< 274
Transonic	0.8–1.2	274–412
Supersonic	1.2–5	412–1715
Hypersonic	5–10	1715–3430
High-hypersonic	10–25	3430–8507

- **Conducted at:** The test was conducted from **Dr APJ Abdul Kalam Launch Complex** at APJ Abdul Kalam island off the coast of Odisha.
- **Implications:** India became the fourth country to have demonstrated this technology after the **USA, Russia and China.**
    - China successfully tested its first **waverider hypersonic flight vehicle** in 2018.
- **Advantages:**
    - The indigenous development of the technology will boost **the development of the systems built with hypersonic vehicles** at its core.
    - It can be developed as a carrier vehicle for **long range cruise missiles** in the defence sector. This includes both **offensive and defensive hypersonic cruise missile systems,**
        - Due to its high speed, most RADARs will be **unable to detect** it. It will also be able to **penetrate most missile defence systems.**
    - This technology will be helpful in the space sector in **development of low-cost, high efficiency reusable satellites.**
- **Disadvantages:** Very high cost.
- **Background:** The DRDO started on the development of the HSTDV engine in early 2010s.
    - The **Indian Space Research Organisation** (ISRO) has also worked on the development of the technology and successfully tested a system in 2016.
    - DRDO **conducted a test of this system in June 2019** also.

Way Forward

- The successful demonstration is certainly a significant milestone towards **Atmanirbhar Bharat.** DRDO with this mission, has demonstrated capabilities for highly complex technology that will serve as the **building block for NextGen Hypersonic vehicles in partnership** with industries.
- While the successful test is a major milestone, **many more rounds of tests** will have to be done to achieve the level of technology with countries like the US, Russia and China.

Source: TH