HAM RADIO COMMUNICATION – SCIENCE & TECHNOLOGY

NEWS: Indian astronaut **Shubhanshu Shukla** will be interacting with Indian students via **ham radio** from the **International Space Station (ISS)**, as part of the **Axiom-4 mission**.

WHAT'S IN THE NEWS?

What is HAM Radio?

- **Definition**: Ham radio, officially known as *amateur radio*, is a *non-commercial and licensed* radio communication service used by hobbyists and enthusiasts for communication, experimentation, and community service.
- **Purpose**: It is used for *educational outreach*, *emergency communication*, *scientific experimentation*, and *personal enjoyment* of wireless communication.

Ham radio (amateur radio), is a licensed, non-commercial radio communication service used for education, experimentation, and emergency communication.
Operators use radio waves, transceivers and antennas to establish contact locally, globally, and even from space.
It was first used in space in 1983 for communication between astronauts and Earth.
The ISS features the ARISS (Amateur Radio on the ISS) system supported by the US, Russia, Canada, Japan, and Europe.

About Radio Waves

- **Nature**: Radio waves are a form of *electromagnetic radiation*, characterized by *long wavelengths* and *low frequencies* on the electromagnetic spectrum.
- **Applications**: Widely used in *communication*, *broadcasting*, *satellite transmissions*, and *radar* operations.
- **Propagation**: They can *travel long distances* and *penetrate materials*, making them ideal for both local and global communication.
- **Atmospheric Presence**: Radio waves primarily reflect and interact in the *thermosphere*, enabling long-distance transmission, especially during ionospheric conditions.

Uses of HAM Radio

- **Educational Tool**: Serves as a platform for *learning electronics, communication technology*, and space science.
- **Emergency Communication**: Functions as a *reliable backup* when conventional networks fail during *natural disasters* or power outages.
- **Knowledge Sharing**: Allows licensed users to *exchange information*, conduct experiments, and build international networks.

Modes of HAM Communication

- **Range**: Communication can be:
    - *Hyper-local* (within a neighborhood),
    - *Long-distance or global* (across continents),
    - *Space-based* (communicating with satellites or the International Space Station).
- **Equipment**: Requires a *transceiver*, *antenna*, and access to *designated amateur frequency bands*.

Licensing in India

- **Age Requirement**: Individuals aged *12 years and above* are eligible to obtain a license.
- **Regulation**: Licenses are issued by the *Ministry of Electronics and Information Technology (MeitY)* under the *Amateur Radio Service Rules*.
- **Examination**: Prospective users must pass a test covering *basic electronics*, *radio regulations*, and *operating procedures*.

Ham Radio in Space

- **First Use**: First used aboard a *NASA space shuttle in 1983* for communication between astronauts and ground-based amateur radio operators.

- **ARISS Program**: The *Amateur Radio on the International Space Station (ARISS)* enables direct communication between astronauts and students worldwide to promote *STEM education*.
- **International Collaboration**: Supported by space agencies and amateur radio bodies from the *US (NASA)*, *Russia (Roscosmos)*, *Europe (ESA)*, *Canada (CSA)*, and *Japan (JAXA)*.
- **Safety Protocols**: Radio communication is *paused during critical operations* like spacecraft docking to avoid interference with essential ISS systems.

Use by Axiom-4 Crew (2025)

- **Mission Context**: During the *Axiom-4 private mission to the ISS*, astronauts from *India, Hungary, and Poland* will use ham radio to connect with students in their home countries.
- **Duration**: Each communication window will last *5 to 8 minutes*, aligned with the ISS's *orbit over each country's horizon*.
- **Objective**: Enhance *educational outreach* and foster *global inspiration* through live interaction from space.

Importance During Emergencies

- **Reliability**: Ham radio operates *independently of the internet or cellular networks*, making it a *critical communication tool* during infrastructure collapse.
- **Indian Case Studies**:
    - *2001 Bhuj Earthquake*: Played a major role when local communication systems failed.
    - *2004 Indian Ocean Tsunami*: Enabled rescue coordination in coastal areas.
    - *2013 Uttarakhand Floods*: Helped maintain links between rescue teams and affected populations.

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