Science & Technology · GS - III

Explain how deep-space communication systems enable spacecraft such as Voyager 1 to transmit scientific data over enormous distances. Discuss their significance for space exploration.

EXAM YEAR	PAPER	SUBJECT
DAILY PRACTICE 06/11/2026	GS - III	Science & Technology

MARKS	WORD LIMIT
10	~150 words

Answer Hint

Radio communication, electromagnetic waves, high-gain antenna, low-power transmission, Deep Space Network, parabolic dish antennas, signal processing, interstellar exploration, scientific research, technological challenges.

Model Answer

Introduction

Deep-space communication enables spacecraft to transmit scientific observations and engineering information across vast distances. NASA's Voyager 1 demonstrates the effectiveness of this technology.

Communication Mechanism

Voyager 1 uses a high-gain antenna and radio transmitter to send signals towards Earth. These electromagnetic signals travel at the speed of light but become extremely weak over enormous distances.

NASA's Deep Space Network (DSN), consisting of large parabolic antennas located at geographically separated sites, receives these signals. Sensitive receivers and advanced processing systems extract useful information from the weak transmissions.

Significance for Space Exploration

Deep-space communication enables scientists to study distant planets, interstellar space and cosmic environments. It also supports spacecraft navigation, monitoring and mission operations.

Challenges

Signal weakening, long communication delays, limited onboard power and ageing spacecraft equipment create significant technical challenges.

Conclusion

Advanced communication networks are essential for scientific exploration beyond Earth. Strengthening such infrastructure will support future interplanetary and interstellar missions.

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