INDUSTRIAL VISIT REPORT

Industrial visit to GIANT METREWAVE RADIO TELESCOPE (GMRT), KHODAD
Date of Visit: 06 February 2026
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1. Introduction :-

An industrial visit to the Giant Metrewave Radio Telescope (GMRT), located at Khodad near Narayangaon, Maharashtra, was organized on 6th February 2026 for the students of Electronics and Telecommunication Engineering. The purpose of this visit was to provide practical exposure to large-scale communication and radio astronomy systems and to bridge the gap between theoretical knowledge and real industrial and research applications.
The visit was very helpful in understanding how advanced electronic systems, antennas, receivers, signal processing units and computer-controlled systems are used together in a real scientific environment. As a student of Electronics and Telecommunication Engineering, this visit helped in understanding how basic subjects such as antennas, communication systems, digital signal processing and networking are applied in a real-world research facility.
The Giant Metrewave Radio Telescope is internationally known for its contribution to radio astronomy and space research. This visit also motivated students to explore higher studies and research opportunities in the fields of communication engineering, signal processing and space science.

2. About the Organization – GMRT :-

The Giant Metrewave Radio Telescope (GMRT) is one of the world's largest radio telescope facilities operating at metre wavelengths. It is located near the village of Khodad, about 80 km from Pune, Maharashtra. The facility is operated by the National Centre for Radio Astrophysics (NCRA), which is a part of the Tata Institute of Fundamental Research (TIFR), Mumbai.
GMRT consists of a large number of parabolic dish antennas distributed over a wide geographical area. These antennas work together as a single large radio telescope using the principle of interferometry. The main objective of GMRT is to study various astronomical phenomena such as galaxies, pulsars, solar activities and other cosmic sources that emit radio waves.
Unlike optical telescopes that observe visible light, GMRT observes radio signals that come from distant objects in space. These radio signals are extremely weak, and therefore very sensitive electronic equipment and signal processing systems are required to detect and analyze them accurately.

GMRT has played a significant role in many national and international research projects and continues to support scientists and researchers from different parts of the world.

3. Objectives of the Industrial Visit :-

The major objectives of the industrial visit were as follows:
To understand the basic working principle of radio telescopes
To study the structure and working of large parabolic antennas
To understand the role of low noise amplifiers and receiver systems
To learn how weak radio signals from space are processed
To understand how multiple antennas are synchronized and controlled
To observe the real-time monitoring and control systems
To relate theoretical concepts of communication and signal processing with practical applications

4. Description of the Visit :-

On 6th February 2026, our group of students from the Electronics and Telecommunication Engineering department visited the GMRT campus at Khodad, Narayangaon. After reaching the campus, we were welcomed by the technical staff and were given a brief introduction about the GMRT facility and its importance in radio astronomy.

The visit started with an introductory session in which the basic concept of radio astronomy was explained. We were informed that radio telescopes do not capture images directly like normal cameras. Instead, they receive radio frequency signals emitted by celestial bodies, and these signals are then converted into useful scientific data using advanced signal processing and computing systems.

We were then taken to the antenna field, where we observed the large parabolic dish antennas. The guide explained the mechanical structure of the antenna, including the reflector surface, feed system and mounting structure. We learned how the antennas are precisely rotated and aligned to point towards a specific region of the sky.
The guide also explained how each antenna receives radio frequency signals and passes them through low noise amplifiers (LNAs) to improve the signal quality. The amplified signals are then transmitted through optical fiber or high-quality cables to the central processing facility.
We also learned about the concept of antenna arrays and how multiple antennas work together to achieve higher resolution and sensitivity. The signals received by different antennas are combined using correlation techniques and digital signal processing.
During the visit, we were shown the control and monitoring systems. The control room uses computer-based systems to schedule observations, control antenna movement and continuously monitor the performance of all antennas. Any fault or abnormal behavior in the system is immediately detected using monitoring software.
The staff also explained the importance of precise time synchronization among antennas. Accurate timing is essential to correctly combine the signals received at different locations. This synchronization is achieved using highly accurate clock systems.
Overall, the visit provided us with a clear understanding of how mechanical systems, electronic hardware, communication links and software systems work together in a large scientific facility.

***5. Technical Systems Observed* :-**

During the industrial visit, the following major technical systems were observed and explained

5.1 Antenna System:

Each GMRT antenna consists of a large parabolic reflector that focuses incoming radio waves onto a feed antenna. The feed system is carefully designed to receive signals over specific frequency bands. The antenna structure is mechanically strong and can be accurately controlled to track astronomical objects.

5.2 Low Noise Amplifier (LNA) and Receiver System:

Since the received radio signals are extremely weak, low noise amplifiers are used at the front end of the receiver chain. These amplifiers increase the signal strength while introducing very little additional noise. The receiver system then converts the received signals to suitable frequencies for further processing.

5.3 Signal Processing and Correlation:

The signals from multiple antennas are processed using digital signal processing techniques. Correlation of signals allows the system to act as a very large virtual antenna. This improves angular resolution and enables scientists to obtain high-quality astronomical data.

5.4 Data Acquisition and Storage:

The processed data is stored in high-capacity storage systems. The data is later analyzed by scientists using specialized software. This requires reliable computer networks and data management systems.

5.5 Control and Monitoring System:

A centralized control system is used to control antenna positioning, observation schedules and system health. Continuous monitoring ensures proper operation and helps in quick fault detection and maintenance.

***6. Relation to Electronics and Telecommunication Engineering Subjects* :-**

This industrial visit was directly related to several subjects studied in the Electronics and Telecommunication Engineering curriculum. The antenna systems were related to the Antenna and Wave Propagation subject. The receiver chains and amplifiers were related to Analog Communication and RF Engineering concepts.
The digital processing and correlation techniques were closely related to Digital Signal Processing. The communication links used to transfer data from antennas to the central facility were related to Data Communication and Networking. The control systems and monitoring software were related to Embedded Systems and Control Engineering.
This visit helped us to understand how different subjects are integrated in a real practical system.

***7. Learning Outcomes* :-**

From this industrial visit, the following learning outcomes were achieved:
Better understanding of radio astronomy and its applications
Practical knowledge of large antenna systems
Understanding of low noise amplification and receiver design
Awareness of large-scale digital signal processing systems
Knowledge of synchronization and timing in distributed systems
Understanding of monitoring and fault management systems
Motivation towards research and higher technical studies

***8. Conclusion* :-**

The industrial visit to the Giant Metrewave Radio Telescope (GMRT), Khodad, on 6th February 2026 was a very valuable and informative experience. It provided practical exposure to advanced electronic systems used in scientific research. The visit helped in understanding how theoretical concepts taught in the classroom are applied in real-world systems.
This visit was especially beneficial for students of Electronics and Telecommunication Engineering, as it covered important topics such as antenna systems, communication links, signal processing and control systems. The experience gained from this visit will be useful for future academic projects and professional careers.
Overall, the visit was successful and highly educational.

I sincerely thank our respected HOD sir and all our teachers for giving us the opportunity to visit the Giant Metrewave Radio Telescope (GMRT), Khodad. I am also grateful to our faculty coordinators for their guidance and support throughout the visit. This industrial visit was very informative and helped us to gain valuable practical knowledge related to our field.