REPORT ON THREE-DAY WORKSHOP

"Recent Trends in Communication and Technology – Pathway from 5G towards 6G"

22–24 January 2026

Organised by IEEE MTTS Student Chapter & Dept. of ACT

NMAM Institute of Technology, Nitte

1. About the Workshop

The three-day workshop on "Recent Trends in Communication and Technology – Pathway from 5G towards 6G" was designed to provide an in-depth understanding of emerging technologies shaping future wireless communication systems. With the rapid evolution of 5G networks and the global push towards 6G, the workshop addressed enabling technologies such as antennas, microwave and millimeter-wave systems, MIMO, beamforming, metasurfaces, and Reconfigurable Intelligent Surfaces (RIS). The sessions combined theoretical foundations, recent research advancements, and practical design considerations, thereby bridging the gap between academic research and real-world implementation.

Sl. No.	Speakers	Designation
1.	Dr. Ashutosh Kedar	Scientist 'G' Electronics and Radar Development Establishment (LRDE), DRDO Chair, IEEE AP/MTT-S Joint Chapter Bengaluru
2.	Dr. Mahesh A	Associate Professor, RV College of Engineering, Bengaluru, SMIEEE
3.	Dr. Goutham Simha	Associate Professor, MIT, Manipal, SMIEEE
4.	Dr. Sukomal Dey	Associate Professor – IIT Palakkad, Chair, IEEE AP-S Chapter, Kerala Section

5.	Dr. Shrikanth Reddy	Associate Professor – IIT Palakkad, SMIEEE
6.	Dr. Praveenkumar	Assistant Professor, MIT, Manipal
7.	Mr. Girish Baliga	General Manager, Industry Marketing, Keysight Technologies, Bengaluru
8.	Dr. Parveez Shariff B G	Assistant Professor and Faculty Advisor – IEEE MTTS SBC, NMAM Institute of Technology, Nitte (Deemed to be University), Nitte

2. Objectives

- To provide a comprehensive overview of wireless communication systems from 5G to 6G.
- To strengthen understanding of antenna theory, microwave engineering, and mmWave/THz systems.
- To introduce the concepts of Reconfigurable Intelligent Surfaces (RIS), MIMO, and beamforming techniques.
- To encourage research orientation and innovation in next-generation communication technologies.

3. Inauguration (22 January 2026 — 9:15 AM – 9:45 AM)

The workshop commenced with a formal inauguration ceremony. Ms. Dhanushree welcomed the gathering and served as the master of ceremonies. The session was presided over by Mr. Adwaith. The Chief Guest, Dr. Ashutosh Kedar, Scientist 'G', Electronics and Radar Development Establishment (LRDE), DRDO and Chair, IEEE AP/MTT- S Joint Chapter Bangalore, delivered the inaugural address. The vote of thanks was delivered by Mr. Mohammed Farhan Riaz, Vice Chair.

4. Day 1 Proceedings – 22 January 2026

Session 1: Keynote Session (9:45 AM – 11:30 AM)

Dr. Ashutosh Kedar delivered an insightful lecture on the fundamentals of antennas and radio wave propagation, grounded in Maxwell's electromagnetic theory. He explained key concepts such as electromagnetic radiation, displacement current, and the principles governing wireless signal transmission over long distances. The session also covered different frequency bands, including ISM bands, along with antenna classifications, radiation characteristics, and commonly used antenna array configurations. Dr. Kedar further discussed array analysis and synthesis techniques, radar system fundamentals, beam shapes, and beamforming methods. In addition, constraints and design challenges associated with phased array antennas, optimization techniques, and modern antenna technologies em- ployed in radar, sensing, and advanced communication systems were highlighted.


Session 2 (11:45 AM – 1:30 PM)

Dr. Mahesh A delivered a detailed lecture on Software-Defined Radio (SDR) integrated antenna array frameworks for future communication applications. He explained the fundamentals of transmitter and receiver chain processing, the necessity of modulation, and core communication principles. The session also addressed communication quality re- quirements for diverse services such as voice, data, Internet of Things (IoT), and multi- media streaming, all operating over a common channel with varying Quality of Service (QoS) demands. Key concepts related to 5G New Radio (NR), including frequency ranges, modulation schemes, multiple access techniques, duplexing methods, channel bandwidth, and peak data rates, were highlighted. In addition, Dr. Mahesh A introduced data rate formulation, SDR hardware components, and demonstrated MATLAB-based antenna ar- ray design procedures, covering RF signal generation, antenna modeling, and bit rate analysis.



Session 3 (2:30 PM – 4:00 PM)

Dr. Goutam Simha delivered an in-depth lecture on intelligent surfaces and spatial modulation techniques for 6G autonomous vehicle-to-vehicle communication systems from a physical layer perspective. He discussed generalized MIMO architectures and addressed practical RF chain limitations such as hardware cost, computational complexity, and inter-channel interference. The session highlighted spatial modulation and index modulation as efficient single-RF chain paradigms, along with related concepts including visible light communication and optical spatial modulation. Dr. Simha further elaborated on Internet of Vehicles (IoV) and 6G-IoV scenarios, emphasizing challenges arising from smart city integration and large-scale vehicular data generation leading to spectrum congestion. The lecture concluded with the mathematical modeling of aggregate interference using Reconfigurable Intelligent Surfaces (RIS) and an overview of future research directions toward 6G, including artificial intelligence integration, performance enhancement, and energy-efficient green communication systems.


5. Day 2 Proceedings – 23 January 2026

Session 4 (9:15 AM – 11:00 am)

Dr. Sukomal Dey delivered an in-depth lecture on multi-band and broadband MIMO antenna systems for 5G and 6G smartphone applications. He emphasized the necessity of multiple-input multiple-output communication employing multiple channels to meet the performance demands of next-generation wireless systems. The session outlined antenna spacing requirements in compact mobile devices and discussed the role of decoupling networks in minimizing inter-antenna interference. Key 5G performance targets, including high bandwidth, low latency, high data rates, and massive capacity expansion, were highlighted. Dr. Dey further explained techniques for reducing mutual coupling through surface-wave and space-wave control while addressing practical constraints related to smartphone form factors. The lecture concluded with a discussion on important MIMO performance metrics such as envelope correlation coefficient (ECC), channel capacity, total active reflection coefficient (TARC), specific absorption rate (SAR) limits, and the implementation of multiple antennas in modern 5G handsets.


Session 5 (11:30 AM – 01:00 AM)

Dr. Shrikanth Reddy delivered a comprehensive lecture on the use of Frequency Selective Surfaces (FSS) for RF and microwave applications. He explained the design and operation of single-band, dual-band, and wideband FSS structures with particular emphasis on electromagnetic wave absorption characteristics. The session covered absorbance formulations using S-parameters and highlighted key design principles such as structural symmetry, periodicity, low reflection, and radar cross-section (RCS) reduc-

tion. Dr. Reddy also discussed unit cell configurations for single-band and dual-band absorbers, along with the development of wideband flexible absorbers offering optical transparency and their applications across radar frequency bands. The lecture concluded with insights into polarization-insensitive absorber performance, energy harvesting us- ing dual-band metasurfaces, terahertz-based sensing applications, and the importance of simulation techniques and boundary condition selection in accurate FSS analysis.

Session 6 (02:15 PM – 04:00 PM)

Dr. Praveen Kumar delivered a comprehensive lecture introducing the fundamentals of RF and microwave engineering. He explained the electromagnetic spectrum, RF and microwave frequency ranges, and their key applications in areas such as wireless commu- nication, radar systems, navigation, medical imaging, remote sensing, and RFID technolo- gies. The session discussed the principles of electromagnetic wave radiation from antennas based on Maxwell's equations, including Gauss's laws, Faraday's law, and Amp ère's law, and related these fundamental laws to antenna behavior. Dr. Kumar further explained wave equations, standard wave propagation speed, and the physical significance of time- varying electric and magnetic fields and currents. The lecture concluded by highlighting the fundamental conditions required for electromagnetic radiation, such as time-varying currents, charge acceleration, current discontinuity, and effective impedance matching.

6. Day 3 Proceedings – 24 January 2026

Session 7 (9:30 AM – 11:00 AM)

Mr. Girish delivered an informative lecture on the evolution of wireless communication systems from 5G to Beyond 5G (B5G) and towards AI-driven 6G smart adaptive networks. He traced the technological progression from early cellular systems such as GSM and CDMA to high-speed, low-latency 5G architectures, and further to extended frequency ranges envisioned for 6G. The session explained the key motivations behind 6G development, including the expansion of business domains, emerging societal needs, exponential growth in data consumption, and the demand for ultra-high-speed connectivity supported by non-terrestrial networks and high-altitude platform systems. Mr. Girish highlighted major 6G use cases such as integrated sensing, advanced robotics, immersive extended reality (XR), global connectivity, massive digital twinning, and sustainability- driven applications. The lecture also introduced artificial intelligence as a critical new dimension in 6G, enabling intelligent communication, enhanced URLLC performance,

and adaptive network operation, and outlined the stages of AI evolution shaping future digital communication systems.

Session 8 (11:15 AM – 12:30 PM)

During Day 3 – Session 2, Dr. Parveez Shariff B G delivered a comprehensive lecture on the design aspects and challenges of millimeter-wave MIMO antenna systems for 5G and 6G applications. He highlighted the advantages of millimeter-wave communication, including wide available bandwidth, compact antenna dimensions, high data rates, and low latency, while also addressing inherent limitations such as reduced coverage range. The session discussed key application areas such as 5G cellular systems, high-definition video transmission, satellite communication, and virtual reality. Dr. Parveez explained how MIMO techniques enhance spectral efficiency and spatial multiplexing performance in multipath propagation environments. The lecture further outlined various antenna configurations, combining techniques, and important performance metrics including en- velope correlation coefficient (ECC), diversity gain, channel capacity loss, mean effective gain (MEG), total active reflection coefficient (TARC), and multiplexing efficiency. The session concluded with an explanation of S-parameters for evaluating reflection and trans- mission characteristics between transmitting and receiving antenna elements.


7. Participants

A total of 184 participants registered for the three-day workshop. The participants primarily consisted of undergraduate students from the Department of Electronics and Communication Engineering (Advanced Communication Technology – ACT), NMAMIT, along with students from other departments of the institute. The workshop witnessed varying levels of attendance across the three days, with Day 1 recording the highest average attendance of 132 participants, followed by 112 participants on Day 2 and 70 participants on Day 3. Despite the gradual decline in attendance over the days, active par- ticipation, interactive discussions, and engagement during technical sessions contributed significantly to the overall success of the workshop.

Attendance Statistical Analysis Report

This report presents a concise statistical analysis of student attendance across three days of sessions.
Total registered participants: 184.

Day	Average Attendance
Day 1	132
Day 2	112
Day 3	70

Day 1 recorded the highest attendance, followed by a gradual decline on Day 2 and Day 3. The overall mean attendance was approximately 105 students, indicating a decreasing participation trend across sessions.

8. Conclusion

The workshop successfully provided comprehensive exposure to recent advancements in communication technologies, with a focused emphasis on the evolution from 5G towards 6G systems. Through expert lectures, technical discussions, and interactive sessions, par- ticipants gained insights into emerging areas such as advanced antenna systems, MIMO

and beamforming techniques, millimeter-wave technologies, metasurfaces, and Reconfigurable Intelligent Surfaces (RIS). The program effectively encouraged participants to develop a research-oriented mindset and explore innovation-driven approaches in next-generation wireless communication systems. Overall, the workshop contributed significantly to enhancing technical competence, research awareness, and professional motiva- tion among the participants.

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