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**B.E. – V SEMESTER MINI PROJECT – II (2025-26)**

# Design and Performance Evaluation of a Microstrip Patch Antenna Through MATLAB Simulation and Practical Testing

## ABSTRACT

The performance of a microstrip antenna is determined by critical parameters such as bandwidth, radiation pattern, gain, polarization, impedance, and efficiency, which collectively define its suitability for specific wireless communication applications. This project presents the design, simulation, and practical validation of a microstrip patch antenna using the MATLAB Antenna Toolbox. The design process begins with theoretical calculations to define the antenna's geometry, materials, and operating frequency, followed by computational modelling to predict electromagnetic behaviour. MATLAB enables detailed parametric analysis, including S-parameter simulations for bandwidth evaluation, 2D and 3D visualization of radiation patterns, gain and directivity estimation, polarization characterization through electric field orientation analysis, and impedance matching verification via port analysis. Efficiency metrics, including radiation and total efficiency, are computed to assess energy conversion effectiveness. A prototype of the designed antenna is fabricated and tested using a Vector Network Analyzer (VNA), with measured results compared against MATLAB simulations. The comparative study reveals close agreement between simulated and experimental data, while highlighting the influence of geometric and material variations on performance. This work demonstrates the MATLAB Antenna Toolbox as a powerful platform for rapid prototyping and performance optimization of antennas, bridging the gap between theoretical design and real-world implementation in both academic and industrial contexts.

**REFERENCES**

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