National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Theoretical and Experimental Investigations on Antennas and Microwave Devices Using Conformal Mapping Technique
Speaker	: Jayanta Bhattacharya (Rollno : 518ec1003)
Supervisor	: Sudipta Maity
Venue	: EC Seminar Room (Room No: EC 303) (External Examiner will join through online mode)
Date and Time	: 28 Apr 2025 (4:00 pm)
Abstract	: In this dissertation, conformal mapping technique is used to investigate different types of microstrip antennas, such as Annular Ring Microstrip Antenna (ARMA), Regular Polygonal Microstrip Antennas (RPMAs), and Irregular Pentagona Microstrip antenna (IPMA). Our theoretical approach is also applicable to different types of Regular Polygonal Waveguides (RPWGs). Here, a general theoretical model is proposed to investigate the characteristics of different regular polygonal waveguides and microstrip antennas with proper physical insights for the first time. In the case of microstrip antenna, internal field patterns of different modes are also plotted using the inverse mapping technique. The resonant frequency of the microstrip antenna for different TM_mnp modes is computed using conformal mapping technique with good accuracy. Input impedance, far-field radiation patterns, radiation efficiency, total quality factor, bandwidth, radiated power, and gain are also computed and discussed here using conformal mapping techniques. Our theoretical results are compared with experimental results and data obtained using 3D EM simulation to show the accuracy of our theory. For waveguide analysis, the cutoff frequency of different regular polygonal waveguides for various TE and TM modes are computed and compared with data found from the open literature and 3D electromagnetic simulator (HFSS). Dispersion diagrams for different RPWGs are also investigated. Internal field patterns of RPWG fo different TE and TM modes are also presented. It is found that our proposed theoretical results are in good agreement with the 3D electromagnetic simulation tool HFSS and the data as found in the open literature. Wave impedance and attenuation coefficients of RPWGs are also investigated using our proposed theory. Our proposed theoretical model provides physical insight into different regular polygonal waveguides. Our mathematical approach can be applied to investigate the rectangular dielectric waveguides for different HEM modes. The exact solutions of the rectangular dielectric waveguide for different HEM modes are still unavailable because the fields in the corner region of the dielectric waveguide cannot be defined properly. This theoretical approach can also be extended to analyze the Koch snowflake fractal antenna. This theoretical approach can be used to study different antenna structures, such as curved or irregularly shaped objects. A conformal mapping technique can be used to analyze the metamaterials and metasurface-based microwave devices. This theoretical approach not only quickly evaluates the performance of a microwave device but also provides the instruction to design it.