

Chief Editor's Message

Editorial

Prof R K Kotnala

FNASC, FIGU, FMSI

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Email: chiefeditor@cnsejournals.org

Decarbonisation & Sustainable Energy Systems for a Healthy India: Nuclear Power, Solar Cells & Hydroelectric Cell!

It is my privilege to write a preface about the very important and special emerging technologies from India in this issue of Current Natural Sciences & Engineering (CNS&E) Journal. Today India's nuclear roadmap aims to expand capacity from 8 GW to 100 GW by 2047, developing nuclear power towards its 2070 net-zero strategy. It also includes indigenous Pressurised Heavy Water Reactors, fast breeder reactors, and thorium-based designs, in parallel with new Small Modular Reactors (SMRs) for industrial decarbonisation. Although Nuclear power is not classified as renewable because it relies on finite uranium resources, it is considered a low-carbon energy source that plays a major role in decarbonisation. It can provide reliable, large-scale electricity with very low lifecycle emissions, though challenges include radioactive waste, accident risks, and high construction costs. Living near nuclear plants is generally safe under normal operations, but accidents or poor waste management can pose risks.

Healthcare is universally recognized as a fundamental right; however, ensuring quality remains indispensable. In this review, the authors highlighted the pressing need to strengthen healthcare standards in India. While numerous government schemes have been introduced to expand access and affordability, medical care delivery must adhere to standardized protocols to ensure reliability, safety, and equity. Within international frameworks, ISO standards provide essential guidance for minimizing risks and enhancing patient outcomes. Recent outbreak of the COVID-19 pandemic has further compelled all of us to recognize the urgency of reinforcing healthcare infrastructure and embedding quality assurance at every level of service delivery. However, addressing these challenges is critical to achieving sustainable, resilient, and patient-centered healthcare for all. Moreover, as the world increasingly turns to India for affordable medical treatment, implementing international standards is vital to sustain trust, ensure patient safety, and position India as a global leader in healthcare excellence.

The rapid expansion of wireless communication systems across microwave and millimetre-wave frequency bands has intensified the demand for compact, multi-band antenna solutions. Modern applications ranging from satellite television broadcasting and radar systems

to 5G millimetre-wave links and advanced sensing platforms require antennas capable of operating simultaneously across the C, Ku, and Ka bands with acceptable return loss, gain, and radiation characteristics within a single compact element. The C band (4–8 GHz) is extensively used for Wi-Fi hotspots, satellite communication uplinks, and weather radar, while the Ku band (12–18 GHz) supports direct broadcast satellite television, VSAT terminals, and airborne radar systems. The Ka band (26–40 GHz) has emerged as a critical frequency resource for 5G millimetre-wave access, high-throughput satellite internet, and advanced imaging radar platforms, making simultaneous multi-band coverage within a single antenna element highly desirable for system integration and cost reduction.

This study presents the design, simulation, and performance analysis of a Coplanar Waveguide (CPW)-fed circular microstrip patch antenna incorporating a strip-line feed mechanism. Fabricated on an FR4 ($\epsilon_r = 4.3$) substrate, it targets four operational frequency bands: 5.5 GHz (C-band, 4.8–6.0 GHz), 16.7 GHz (Ku-band, 15.8–17.5 GHz), 26.3 GHz (Ka-band / 5G mmWave, 25.5–27.5 GHz), and 34.6 GHz (Ka-band, 33.5–36.0 GHz). Two antenna configurations have been investigated. The optimised antenna achieves bandwidths of 1.2 GHz, 1.7 GHz, 2.0 GHz, and 2.5 GHz at the four resonance frequencies, covering applications spanning Wi-Fi, satellite communications, 5G mmWave, and advanced radar systems. Simulated E-plane and H-plane radiation patterns at all four operating frequencies, surface current density distributions, and S-parameter analysis confirm robust multi-band performance within a compact FR4-based physical footprint.

The global demand for a low-cost, 24-hour green energy device to replace solar cells led to the invention of the hydroelectric cell which generates green electricity using water splitting on nanoporous metal oxides, ferrites, and composites. Hydroelectric Cell (HEC), a green energy device, is a revolutionary ground breaking invention validated and recognised globally from India that generates green electricity and hydrogen directly from water at room temperature, without sunlight, acid, alkali, or catalyst, based on water splitting. HEC is an alternative to Solar Cell & Fuel Cell and is the biggest invention of the 21st century in the green & clean energy domain. Moreover, it is a unique path-breaking invention that holds immense potential for achieving net-zero carbon emissions and has been upheld as a potential game-changer in decarbonization to fight global warming & climate change, achieved within seven years of its invention in 2016.

The presented study investigates the Hydroelectric Cell (HEC) performance of pristine and lithium-doped tantalum oxide (Ta_2O_5), which is a 33rd compound used for Hydroelectric Cell device fabrication within nine years of HEC invention. Experimental results demonstrate that doping Ta_2O_5 with lithium significantly enhances current and power output compared to the pristine sample.