(#59) Designing of the Dynamic Behavior of Planetary Gear System in Mini Hydro Power Plant

K.J.T.S. Fernando[1], Chamil Gunarathne[2]

[1,2]Faculty of Engineering, NSBM Green University, Sri Lanka

Abstract

This research focuses on designing a novel planetary gear system for mini hydro power plants to enhance turbine rotation efficiency and overall transmission performance. In Sri Lanka, the mini hydro industry, with a potential of 400 MW, often encounters inefficiencies due to suboptimal turbine speeds in conventional setups, which typically utilize diversion systems, dams, and pumped storage methods. Our study proposes a 3-stage planetary gear system to address this issue by efficiently transferring power from the turbine to the generator. The methodology involves problem analysis, solution design, mathematical calculations, and dynamic analysis using software, followed by CAD simulations and prototype manufacturing based on specific material parameters. The final step includes analyzing the dynamic behavior of the prototype to ensure smooth operation and addressing challenges like wear, noise, and vibration. Results indicate that the proposed system achieves a gear ratio of 106.23, significantly enhancing speed and torque. Experimental testing shows that the system can increase speeds up to 1000 rpm, enabling generators to handle loads exceeding 1500 kW effectively. This innovative approach promises to revolutionize the mini hydropower sector by optimizing power consumption and advancing technology. The study emphasizes the importance of integrating precise parameters in the design process and suggests future research directions, including the use of advanced materials and condition monitoring strategies to further improve planetary gear systems. This groundbreaking design sets a new standard for efficiency and reliability in mini hydro power plants.

Keywords: *Hydroelectric power station, Mini Hydro plant, Planetary gear system, Turbine rotation speeds, Transmission system*