

# ABSTRACT

The increase in pollution and decrease in fossil fuel reserve leads us to a conclusion of replacing thermal energy with steady and continuous renewable / non-conventional energy. The researches presented in this thesis aim to contribute to the advancement of sustainable energy solutions and promote the adoption of green technologies in the field of microgrid systems, completely eliminating the presence of fossil fuel in terms of eliminating diesel generator, as a backup storage.

The novelties implemented in the flow of research firstly, lie in the innovative design modifications made to a wind turbine system. The wind turbine has been adapted to alternately charge one Pumped Storage Hydro (PSH) system and one Gravity Energy Storage System (GESS). This modification ensures a continuous and stable supply of renewable-based electricity, by utilizing both storage systems effectively. Secondly, the wind turbine has been further enhanced to simultaneously charge and discharge two GESSs. This feature enables uninterrupted renewable-based electricity supply with lower land requirement. This design modification is crucial for ensuring a reliable and consistent power supply from renewable sources to the places with land scarcity and unable to establish a PSH. Lastly, a system design has been developed to ensure continuous operation of the wind turbine system. This includes the integration of various components to optimize the performance and efficiency of the system, ultimately leading to a reliable and sustainable source of electricity along with its LCOE (Levelized cost of energy), that is at par with the domestic unit electricity price of the place, established by the state government.

Overall, the novelties of this work showcase the potential for enhancing the capabilities of wind turbine systems to provide continuous and stable renewable-based electricity supply. These advancements have the potential to significantly contribute to the transition towards a more sustainable energy future.