PRESIDENCY UNIVERSITY
Private University Estd. in Karnataka State by Act No. 41 of 2013
Itgalpura, Rajankunte, Yelahanka, Bengaluru – 560064

Cyber-Security Enabled Smart Controller for Grid-Connected Microgrid

A PROJECT REPORT

Submitted by

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Under the guidance of,

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BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

PRESIDENCY UNIVERSITY

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PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

Certified that this report "Cyber-Security Enabled Smart Controller for Grid-Connected Microgrid" is a bonafide work of "ABDUL SAMAD (20221CSE0121), SIDDIQUE ALI KHAN (20221CSE0048) & MOHAMMED ANZAL A (20221CSE0026)", who have successfully carried out the project work and submitted the report for partial fulfilment of the requirements for the award of the degree of BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE & ENGINEERING during 2025-26.

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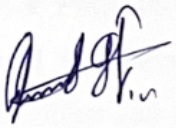
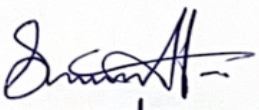
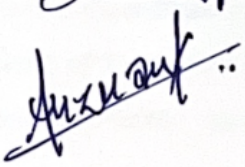
DECLARATION

We, the students of final year B.Tech in COMPUTER SCIENCE ENGINEERING at Presidency University, Bengaluru, named ABDUL SAMAD, SIDDIQUE ALI KHAN & MOHAMMED ANZAL A, hereby declare that the project work titled **"Cyber-Security Enabled Smart Controller for Grid-Connected Microgrid"** has been independently carried out by us and submitted in partial fulfilment for the award of the degree of B.Tech in COMPUTER SCIENCE & ENGINEERING during the academic year of 2025-26. Further, the matter embodied in the project has not been submitted previously by anybody for the award of any Degree or Diploma to any other institution.

Abdul Samad	USN: 20221CSE0121	
Siddique Ali Khan	USN: 20221CSE0048	
Mohammed Anzal A	USN: 20221CSE0026	

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Abstract

Grid-connected microgrids have become a critical component of modern power systems, providing improved reliability and integration of renewable energy sources. Due to increased reliance on cyberspace systems, microgrids and their connection to the central grid suffer from a range of cyber threats: Data Injection, Denial of Service, or Man in the Middle. These systematic assaults are not the sole focus. However, the cyber threats jeopardize the economically and operationally efficient balance of the systems. Cyber perimeter defences have been constructed into the design, which employs military-grade elliptic curve cryptography to assure isolated communication. This paper describes a multifunction smart controller consisting of cyber defences with real-time lockers for secure communications, ECC, lightweight blockchains for immutable audit logs, and hybrid integrated anomaly detection for cyber-physical system defences. The advantages of ECC, in this case, include the establishment of low-latency secure communication. Blockchain provides operational integrity, real-time data, and traceability. The proposed hybrid model improves the accuracy and reliability of detecting intruder systems and other malfunctions in operational cyber-physical systems. Additionally, a dashboard provides operators with real-time monitoring and control capabilities. This system's uniqueness lies in its ability to combine several cybersecurity technologies into one seamless system, which optimizes real-time processing on microgrid controllers and balances system performance with security. The proposed framework also emphasizes modularity. Each security layer such as encryption, blockchain auditing, and anomaly detection is designed to operate independently while contributing to the resilience of the whole system. This layered approach ensures that even if one subsystem experiences failure or compromise, the remaining modules continue to protect the microgrid effectively. In addition, the monitoring dashboard enhances the operator's situational awareness by providing real-time alerts, intuitive visualization, and actionable insights that support timely decision-making. Beyond its technical innovation, this system contributes to the broader vision of secure and sustainable energy infrastructures. By addressing cybersecurity challenges in microgrids, the project supports renewable energy integration and protects critical infrastructure against evolving digital threats. The combination of ECC, blockchain, and anomaly detection provides a future-ready solution that is scalable and adaptable across different environments. This research also aligns with several Sustainable Development Goals, including affordable and clean energy, innovation in industry and infrastructure, and the creation of safe and resilient communities.