Annexure – A

Project Title: AI-Driven Multi-Model Framework for Real-Time Energy Anomaly Detection in Smart Grids

Abstract:

Energy theft and operational anomalies in smart meters pose significant challenges to the modern energy infrastructure, leading to substantial financial losses and compromised system reliability. Traditional detection methods fail to address these challenges effectively, resulting in significant financial and operational inefficiencies. This research proposes an AI-driven framework for real-time anomaly and theft detection in smart meters, leveraging advanced machine learning and deep learning algorithms. The framework integrates Support Vector Machines (SVM), Random Forests (RF), Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), and Autoencoders to identify and mitigate anomalies such as unauthorized energy usage, tampering, and data irregularities. By utilizing real-time data from smart meters, including voltage, current, and power factor, the system detects unusual consumption patterns and tampering with high accuracy. Key features include real-time monitoring, adaptive learning, and predictive analytics, achieving high detection accuracy, minimal false positive rates, and better response times. These algorithms work in tandem to process and analyze real-time data from smart meters and network logs, enabling accurate detection, classification, and prevention of energy anomalies. The solution is validated through simulations using real-world datasets and hardware setups, offering a scalable and robust defense mechanism for energy providers. This work aims to enhance grid resilience, reduces energy theft, reduce financial losses, and foster innovation in energy management by leveraging both traditional and advanced AI techniques.