INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : **Ph.D.**

Thesis Title: **Development of Regenerative Braking System and Sensor Fault-Tolerant Algorithm for Electric Vehicles in Hilly Region**

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SHORT ABSTRACT

Electric Vehicles (EVs) are pivotal to the global shift toward sustainable technology, and India is embracing this movement, particularly with electric two-wheelers. However, EV adoption in India's hilly regions remains limited due to increased energy demands caused by road gradients. This thesis addresses these challenges, focusing on making electric two-wheelers more viable for hilly terrains.

A key limitation of EVs is their reduced range, driven by the lower energy density of batteries compared to gasoline. On hilly roads, energy consumption rises significantly during climbs. One solution is regenerative braking systems (RBS), which recover energy during descents by converting kinetic energy into electrical energy to recharge the battery. This thesis presents a modular regenerative braking circuit designed for low-speed, high-torque applications in hilly conditions. Two control strategies—classical type-II compensator and a sliding mode control-based method—were developed and validated through MATLAB/Simulink simulations and experimental tests. Results confirm effective energy recovery, braking performance, and battery recharging.

Additionally, the thesis addresses sensor failure in Brushless DC (BLDC) motors, widely used in electric two-wheelers. A simple fault-detection algorithm is proposed to maintain motor operation even if one Hall effect sensor fails, enhancing reliability.

This work provides a holistic analysis of hilly road challenges and practical solutions, offering insights into regenerative braking design and fault management in BLDC motors. It aims to improve the feasibility of electric two-wheelers in hilly regions, contributing to the broader adoption of EVs in India.