National Institute of Technology Rourkela

Registration Seminar

Seminar Title	: A Switched-Converter-Based Active Cell Balancing Topology for Series-Connected Lithium-Ion Battery Packs
Speaker	: Pratyay Maity (Rollno : 922ee5001)
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Venue	: Seminar Room (EE-401), Department of Electrical Engineering
Date and Time	: 09 Oct 2025 (4.30PM)
Abstract	: State-of-charge (SoC) estimation with voltage balancing of series-connected lithium-ion battery packs is a crucial requirement to enhance safety, extend cycle life, and maximize energy utilization. Active balancing methods are increasingly preferred over passive approaches for applications where efficiency, autonomy, and reduced energy losses are critical. In this work, advanced circuit topologies for active equalization are proposed and analyzed in detail. A novel non-dissipative two-stage equalization circuit, derived from the traditional buck&ndashboost configuration, is introduced to achieve high-efficiency voltage balancing without the need for additional external components, thereby reducing cost and system complexity. The operational principles, control methodologies, and structural implementation of the proposed topology are systematically described and supported with illustrative figures. Furthermore, an improved SoC and voltage-based active balancing technique is introduced, addressing the limitations of conventional designs by offering greater compactness, reduced filtering requirements, and simplified implementation. To validate the proposed concepts, a MATLAB-based simulation environment is developed. A prototype equalization circuit is also designed and fabricated to experimentally assess performance. Results obtained from both simulations and experiments, including tests on a six-cell series-connected pack, confirm that the proposed architectures achieve reliable, efficient, and cost-effective voltage equalization. The findings demonstrate the practical feasibility of the designs and highlight their potential for application in large-scale lithium-ion battery systems, particularly in energy storage and electric vehicle technologies.