Department of Mechanical Engineering
IIT Madras

Seminar title: Effective battery thermal management techniques for high capacity pouch cells

Date/Time: 20-02-2025; 3:00 PM

Venue: Through Google Meet**:** https://meet.google.com/wwn-oeqv-jic

Speaker: Mr. Hemanth D (ME20D701)

Biography of the Speaker: Ph.D. Research Scholar in the Department of Mechanical Engineering

Affiliation of the Speaker:

Guide: Dr. Arvind Pattamatta (ME), Co-guide: Dr. Pallab Sinha Mahapatra (ME)

DC members: Dr. Dhiman Chatterjee (ME) (Chairperson), Dr. Ashis Kumar Sen (ME), Dr. Pushpavanam S (CH), Dr. Shyama Prasad Das (ME)

Abstract:

Electrification in the automotive sector is rapidly advancing worldwide to reduce reliance on fossil fuels. Li-ion cells are the preferred power source for electric vehicles (EVs); however, their performance, lifespan, and safety are highly dependent on operating temperature. These cells operate optimally between 25- 45°C, as exceeding this limit accelerates degradation, leading to capacity loss and faster aging. Consequently, an efficient battery thermal management system is crucial. The thermal management system must also be lightweight to minimize impact on vehicle range. As temperature distribution on Li-ion pouch cell is non-uniform, infrared thermography (IR) is employed to identify hotspots and critical cooling regions. Departing from the conventional method of cooling the entire cell surface, a novel T-shaped cold plate (TCP) is designed for targeted liquid cooling based on the insights from the IR studies. Made of lightweight aluminum, the TCP is strategically placed on the cell surface to effectively target high-temperature zones while minimizing overall system weight. Experimental testing demonstrates that the TCP successfully maintains cell temperatures within safe operating limits. Various flow configurations are analyzed using performance metrics that balance thermal performance with energy efficiency. The TCP-based cooling strategy is then scaled to the module level through numerical simulations, confirming its effectiveness at the module level. Following this, further optimization studies refine the TCP design, enhancing cooling efficiency while reducing weight. The optimized TCP outperforms the initial design, offering improved thermal management along with weight reduction and material cost savings. This approach offers a lightweight, cost-effective solution for next-generation EV thermal management, balancing battery health and overall energy economics. The findings contribute to the development of more efficient BTMS tailored for modern electric vehicles.