



Battery Thermal Management

Short Term Course (Hybrid Mode)

About IIT Kharagpur

History

First in the chain of IITs to be set up by the Government of India, Indian Institute of Technology, Kharagpur started in 1951 in the erstwhile Hijli Detention Camp. It has now blossomed into one of the finest technical institutions in the world. Spread over a sprawling campus of 2100 acres, it is largest and most diverse technical institution in the country offering programmes in Bachelors, Masters and Ph.D. levels in all disciplines of engineering, basic sciences, medical and life sciences, management, law and humanities.

Location

Situated about 120 km west of Kolkata, Kharagpur can be reached in about 2 hours by train from Howrah railway station of Kolkata or 3 hours by car from Kolkata Airport. Kharagpur is also connected by direct train services to most major cities of the country. The Institute is about 10 minutes drive (5 km) from the Kharagpur railway station. Private taxi, auto rickshaw or cycle-rickshaw can be hired to reach the Institute.

Weather

Winter (October to February) is moderate and pleasant (10 to 25 C) in Kharagpur. Summer (March to June) is hot (25 to 40 C) and sometimes humid. Rains are normally confined to the months of June to September.

Contact

Office of Continuing Education
Indian Institute of Technology Kharagpur,
Kharagpur – 721302
West Bengal, INDIA
Email: adeanoutr@iitkgp.ac.in

Overview

The demand for clean and sustainable energy sources has become a strong driving force globally to move towards a sustainable clean environment and be resilient against disruption in energy resource supply chain. The search for a clean and green propulsion system has gained new momentum due to increased demand and cost of imported oil, uncertainty in steady supply of oil, meet increasingly higher emission standards, and be resilient against disruption in energy resource supply chain. In this context, electric battery storage has been recognized to be key players of clean energy technologies due to their high efficiency, high energy density, and low or zero emissions.

With the rapid decrease in the cost of battery storage, the EV vehicle market is undergoing an accelerated growth worldwide. Lithium – Ion batteries are now extensively used in electric vehicles (EV) as well as in renewable power generation applications for both on-grid and off-grid storage. All major automakers around the world are moving towards developing and deploying more electric vehicles and lesser numbers based on internal combustion engines. Electrification efforts are also made in many other industries like truck makers, earth moving equipment, agricultural equipment. However, the competition and urge to improve performance and safety as well development of new generation of battery cells and designs with increased energy and power densities, longer range, faster charging, and safer operation are also intensifying.

Even with growing interest in battery electric vehicles, industry is still facing several challenges in gaining wider adaptation in market. There is momentous need to improve the battery storage designs along with efficient thermal heat management techniques to improve energy and power densities, efficiency, lower cost, weight, and longer life. Also, search and explore different battery materials and elements that could last longer and charge faster. The rapid advances in battery storage system development and deployment require basic science and battery technology as well as advanced information on battery design and analysis including thermal heat management solutions for the electrification of modern electric vehicles including thermal heat management solutions.

Objectives of the Course

This course is designed to provide a basic knowledge of the principles and analysis methods required for the design and packaging of battery storage in EVs meeting thermal heat management requirements. The focus of the course will be on understanding the challenges and requirements of battery storage design; addressing the challenges and sustaining enhanced battery performance, safe operations, longer range and reduce rate of degradation of the EV battery storage during charging and discharging duty cycles using thermal heat management methods and tools. The aspects which are often neglected is the consideration of the efficient thermal heat management and packaging in the design phase that may lead to potentially catastrophic consequences such as thermal runaway and fire. Students will be exposed to the underlying scientific and technological knowledge-base that are essential to become proficient designers and builders of EV battery storage systems.

Course Schedule and Methods

Dates: March 10,11, 2023
Duration: 9 hours

Eligibility

- Engineers, managers/executives and researchers from design and manufacturing companies responsible for building, using and sustaining electronic products.
- Researchers from R&D laboratories working on Electronic Packaging, Design and Manufacturing
- Graduate students and senior undergraduate students from reputed academic and technical institutions at all levels seeking careers in design and packaging of battery storage systems
- Faculty from reputed academic and technical institutions

The course does not have any pre-requisites and is designed to cater to an audience with diverse backgrounds. Some introductory level understanding of Basic Electronics, Mechanics of Solids and Heat Transfer will be helpful.

Important Dates

Last date for receiving application: 5th March, 2023

Course Contents

- 1 Introduction: challenges and requirements of battery storage design
- 2 Basic components, operations, and classification of Li-ion battery
- 3 Thermodynamics, electrochemical kinetics, and transport phenomena in battery
- 4 Performance characteristics, heat generations and duty cycles
- 5 Thermal runaway phenomena, safety, and thermal heat management challenges.
- 6 Experimental characterization and testing
- 7 Simulation models and tools
- 8 Battery charging challenges, strategies, and infrastructures
- 9 Battery pack design strategy and battery packaging elements
- 10 Active and passive thermal heat management methods

The Faculty



Dr. Pradip Majumdar is the Founder & CEO at DSinnovtech, USA and Co-Founder of EBENSTO, India. Dr. Majumdar earned his M.S. and Ph.D. in mechanical engineering from Illinois Institute of Technology. He is an adjunct professor at Illinois Institute of Technology, USA. He was a professor and the chair of the Department of Mechanical Engineering at Northern Illinois University (NIU). He is the recipient of the Faculty of the Year Award for Excellence in Undergraduate Education.

Dr Majumdar's expertise and research includes AI-Machine Learning (ML) /Data Analytics; Advanced Simulation and Modeling; IoT/ML Application Developments. Renewable Energy and Power generations; Thermo-Fluid Sciences; Computational Fluid Dynamics (CFD) and Heat Transfer; Finite Element Methods; Fuel Cell Energy Systems; Li-Ion Battery Storage Design and Analysis; Engine combustion, Thermal Heat Management; Electronics and Battery Cooling; Nano-structured Material; Thermal Interface Materials (TIM); Electronics Cooling; Experimental Methods and Analysis; High energy Laser Material processing; and Transport Phenomena in Biological Systems. Dr. Majumdar has been the lead investigator for numerous federal and industrial projects. Dr. Majumdar has authored over 125 referred technical papers and authored four textbooks: *Computational Methods for Heat and Mass Transfer*; *Fuel Cells- Principles, Design and Analysis*; *Design of Thermal Energy Systems*; and *Computational Fluid Dynamics and Heat Transfer*.

Dr. Majumdar is professionally highly active in organizing and chairing national and internal conferences, workshops in heat and mass transfer, computational fluid dynamics, micro-nanoscale heat transfer, electronics cooling, fuel cell energy systems, LI-ion Battery storage. He has been highly active in making keynote and plenary speaker presentations at national/international conferences and workshops. Dr. Majumdar has participated as an international expert in GIAN lecture series on fuel cell and Li-ion battery storage. He was highly active in professional societies and was an active member of ASME technical committees such as K-16: Heat Transfer of Electronics and K-20: Computational Heat Transfer. Dr. Majumdar is a Fellow of ASME.

Dr. Majumdar was the editor of *International Communications in Heat and Mass Transfer* (ICHMT) and an *Associate Editor of ASME Journal of Thermal Science and Engineering*. He is currently serving as a member of Editorial Advisory Board of ICHMT and a member of the Editorial Board of *International Journal of Nanoparticles and Nanotechnology*.

Registration Fees

Mode of Delivery: HYBRID

IIT Kharagpur students: INR 100 + GST

Students of other institutions: INR 300 + GST

Participants from Industry: INR 3000 + GST

Faculty from academic Institutions: INR 1000 + GST

Accommodation

Accommodation and food for participants can be arranged on separate payment basis.

Registration Link

Please register at:

<https://erp.iitkgp.ac.in/CEP/courses.htm>

Course Coordinators

Dr. Anandaroop Bhattacharya

Phone: +91 3222 - 282946

E-mail: anandaroop@mech.iitkgp.ac.in

Dr. Somnath Roy

Phone: +91 3222 - 282946

E-mail: somnath.roy@mech.iitkgp.ac.in

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10 - 11 March, 2023