

Proposed e-ITEC/ITEC Course 2022-23

**Electrochemical Energy Storage for Electric Vehicle and
Renewable Energy Systems**

Dates: 6th February 2023 – 17th February 2023

Venue/ Mode: Online

Coordinators

Prof. Anil Verma and Prof. Anupam Shukla

Department of Chemical Engineering

PART A	Synopsis, Aim, Objectives, Course Contents, Outcomes, Audience, Eligibility
PART B	Indian Success Stories, Govt & Pvt Sector Engagement, Sectoral Focus, Rationale
PART C	Co-ordinator Contact Details



Electrochemical Energy Storage for Electric Vehicle and Renewable Energy Systems

PART A

(Synopsis, Aim, Objectives, Outcomes, Audience, Eligibility)

a. **Course Synopsis:**

Excessive utilization of fossil fuel derived energy has posed adverse situations of climate change. To address such alarming situations, the nations across the globe are putting collective efforts for promoting the usage of renewable energy. In recent COP26 summit held in Glasgow, India has committed that by 2030, 50% of India's electricity requirement will be fulfilled by renewable energy. Moreover, India has promised to cut its emissions to net zero by 2070. Though, adopting renewable energy for a greener and cleaner environment is practically the most viable solution to tackle climate change but the intermittent nature of the renewable energy makes the task challenging. Therefore, the success and the sustainability in the current ecosystem is primarily dependent on the availability of technologically and commercially viable renewable energy harnessing and storage technologies. In addition, the adoption of electric vehicle (EV) is an important component of meeting the COP26 target. Electrochemical energy storage devices play a key role in both EV and renewable energy system. Batteries are the key component of electric vehicle and are the prime determiner of the cost and range of EV. Intermittent nature of renewable energy necessitates the used of EES for bridging the gap between generation and demand.

Over the past two decades Electrochemical energy conversion and storage (EES) has become an important component of the energy architecture of India as well as the advanced and other developing countries and its penetration in all aspect of life is increasing with time. Indian researchers and industries are developing

technologies and products that will help in achieving the targets of COP26. Moreover, Indian experience can also motivate the African countries to undertake the similar developmental efforts. The course will provide an overview of the technology, economic, and policy aspects of the EES and its applications.

b. Aims of the Course:

The course will focus on the electrochemical technologies for EV and renewable energy systems with emphasis on the current Indian scenario, status of private industries, and the role of government policies in promoting EV and renewable energy sector.

c. Course Objectives / Learning Objectives:

The course objectives include:

- Overview of electrochemical storage technologies
- State of art of the storage technologies employed in EV and renewable energy space with focus on Indian scenario
- Role of government policies and academia-industry partnership
- Future direction

d. Course Outline (Draft)

Module No.	Contents	Date & Duration (tentative) 6 Feb 2023 to 17 Feb 2023
1	Overview of EV and Renewable Energy Systems	06-07/2/2023, 3 h
2	Introduction to Electrochemical Energy Storage and its Role in EV and Renewable Energy Systems	07-08/2/2023, 4 h
3	Relevant Electrochemical Energy Storage Devices/Technologies <ul style="list-style-type: none"> ➤ Batteries ➤ Flow Batteries and Supercapacitor ➤ Fuel Cells 	08-09/2/2023, 3 h 09-10/2/2023, 4 h 10/2/2023, 3 h
4	Quiz-1	13/2/2022, 1 h

5	Batteries for EV and Renewable Energy Storage: Current Status including Indian Scenario ➤ Quiz discussion	13-14/2/2023, 4 h
6	Indian Policies and Schemes (PLI, FAME, etc.)	15/2/2023, 3 h
7	Future Directions in Energy Storage	16/2/2023, 2 h
8	Course Closure ➤ Quiz-2 and Discussion on Quiz-2 ➤ Course Feedback	17/2/2023, 3 h

e. **Expected Outcomes of the Course:**

The course will provide a comprehensive overview of the role of electrochemical energy storage in electric vehicle and renewable energy sector. The participants will be exposed to the development and deployment of these technologies in Indian industries and Indian society, and the catalytic role of Indian policies. This course will help the participants to appreciate the Indian success and enable them to apply the knowledge gained in the course in their respective area.

f. **Target Audience:**

This course is designed for policy-makers, government officials, senior academicians/researchers, entrepreneurs, and participants from industry.

g. **Eligibility of the participants:**

Diploma/Degree in Engineering or Science or Economics with preference to those having exposure/experience in energy sector. Those aspiring to work in the energy sector may also be considered.

h. Minimum and Maximum Participants

Minimum 10 and maximum 30

i. Platform to be used for the online classes (in case of e-ITEC programme)

MS Teams or Zoom

j. Evaluation Criteria

Two quizzes, one in mid of the course and another at the end of the course.

PART B

(Sectoral Focus, Indian Success Stories, Govt & Pvt Sector Engagement, Rationale)

Sectoral Focus: Energy Sector, specifically electrochemical energy storage with application in EV and renewable energy.

Examples of Indian Success Stories: Examples of Indian EV like Tata Nexon in 4-wheeler; Hero Electric in 2-wheeler; JBL in Electric Buses; Tata's Fuel Cell Bus; ISRO's Programme on Fuel Cell for Remote Areas; Rooftop Solar PV for Domestic use (TATA BP, and Indian Government Policies and Schemes).

Exposure to Indian Policy and Governmental Setup: Production Linked Incentive (PLI) Schemes; Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME); MNRE Schemes; Saubhagya Scheme, etc.

Connect to Private Sector & Industry: The proposers of the course are also coordinating an ongoing certificate course in electric vehicle technology that has more than 40 participants from different automobile and original equipment manufacturer (OEM) industries.

Rationale: Electrochemical energy conversion and storage has become an important component of the energy architecture of India and its penetration in all aspect of life is increasing with time. Indian researchers and industries are developing technologies and products that will help in achieving the international targets. Indian experience can motivate the African countries as well as developing countries of Asia, South & Central America, and eastern Europe to undertake the similar developmental efforts. The course will provide an overview of the technology, economic, and policy aspects of the electrochemical energy storage domain.

PART C
Co-ordinator Contact Details

Course Coordinators:

1. Prof. Anil Verma & Prof. Anupam Shukla
Department of Chemical Engineering
IIT Delhi

Weblink:

1. <https://web.iitd.ac.in/~anilverma/>
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Mob.: 9717397213 (Anil Verma)

Link to CV of Course Coordinator

1. <https://owncloud.iitd.ac.in/nextcloud/index.php/s/YCnJEttTk5Y43LJ> (Anil Verma)
2. <https://drive.google.com/file/d/13bISCtckPY5MZbfrMhGofx7Q0shHVWfF/view?usp=sharing> (Anupam Shukla)