



भारतीय प्रौद्योगिकी संस्थान दिल्ली  
Indian Institute of Technology Delhi

# Advanced Programme in Electric Vehicle (EV) Technology

(Batch 5)

6 Months | Live Online | Starts on 19th November 2023

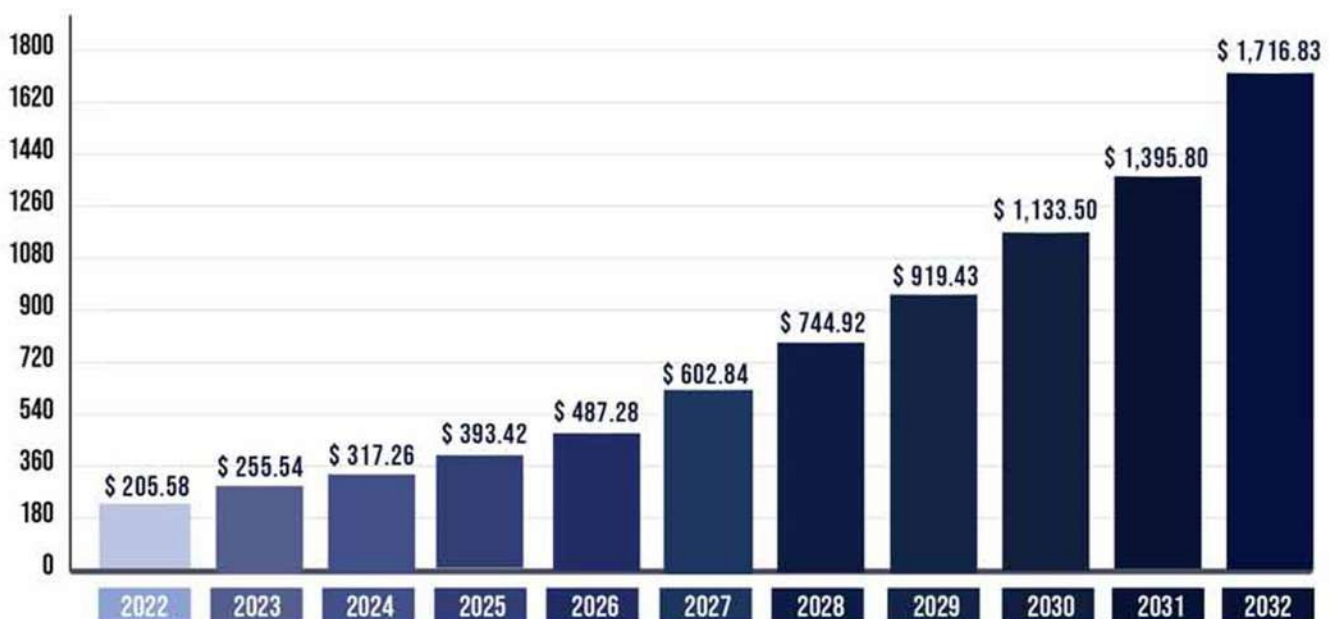


Programme offered by Continuing Education Programme (CEP), IIT Delhi

# Electric Vehicle: The Next Growth Engine in Today's Turbulent Times

“The global electric vehicle market size accounted for **USD 205.58 billion in 2022** and it will increase at **USD 1,716.83 billion by 2032**. It is growing at a compound annual growth rate (CAGR) of **23.1%** during the forecast period **2023 to 2032** (Precedence Research).”

**ELECTRIC VEHICLE MARKET SIZE, 2022 TO 2032 (USD BILLION)**



“

India's automobile sector alone is worth hundreds of billions of dollars, contributing to around 7% of our GDP. Comparatively, the EV industry is predicted to **reach \$15 billion by 2030** before continuing to climb. In the next 10-12 months, the Electric Vehicle (EV) ecosystem requires over 10,000 engineers. However, the current talent supply is insufficient due to the scarcity of individuals with relevant skills. This presents a favourable scenario for graduates and professionals seeking to enter the EV industry. By enhancing their skill set now, they can acquire highly sought-after profiles and open themselves up to several promising opportunities (as per the report by India Today).

”

# Overview

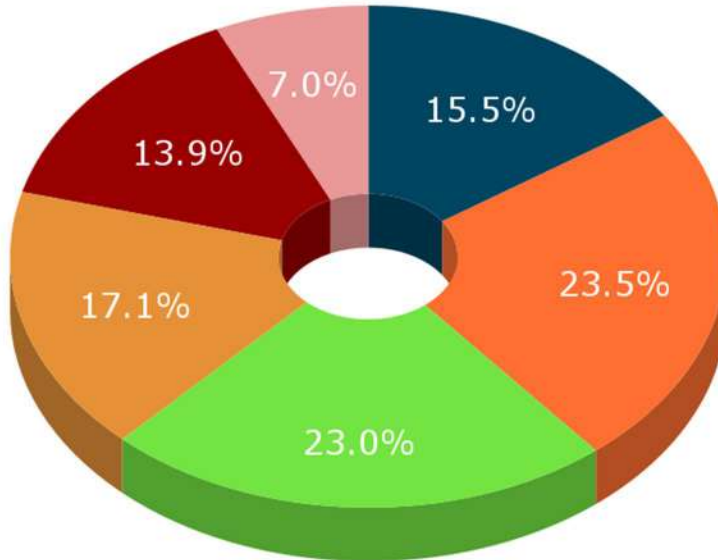
Electric vehicles are considered to be an important step towards mitigating dependency on crude oil, protecting the environment and improving transportation sustainability. Many manufacturers have made major investments in electric automobile technology opening up employment and growth opportunities for individuals with knowledge in the required field. The E-Mobility space encompasses several technologies: the important one being electrochemical energy storage and conversion, electric drivetrain, power electronics, etc. The electrochemical energy storage and conversion devices used in Electric Vehicles (EV) are primarily batteries, fuel cells, and supercapacitors. These devices invariably require power electronic interface to couple with the vehicle drivetrain and charging stations.

The programme will provide a basic understanding of the working of the storage devices from a single cell to pack level, duty cycles led sizing of storage, and basics of power electronics required for interfacing devices with drivetrains. The programme content will also include various aspects of charging from device to electrical grid level as well as an introduction to smart grids, net metering and system integration. Thus the programme is designed to provide a comprehensive view of the Electric Vehicle (EV) Technology to individuals and working professionals. The programme will help to cater for the training and development need of industry 4.0 and enable the participants to build the required skill set, capabilities and knowledge in the e-mobility domain.



## Recent Batch Profile

### Work Experience (in years)



● 0-3 ● 3.1-7 ● 7.1-11 ● 11.1-16 ● 16.1-20 ● 20+



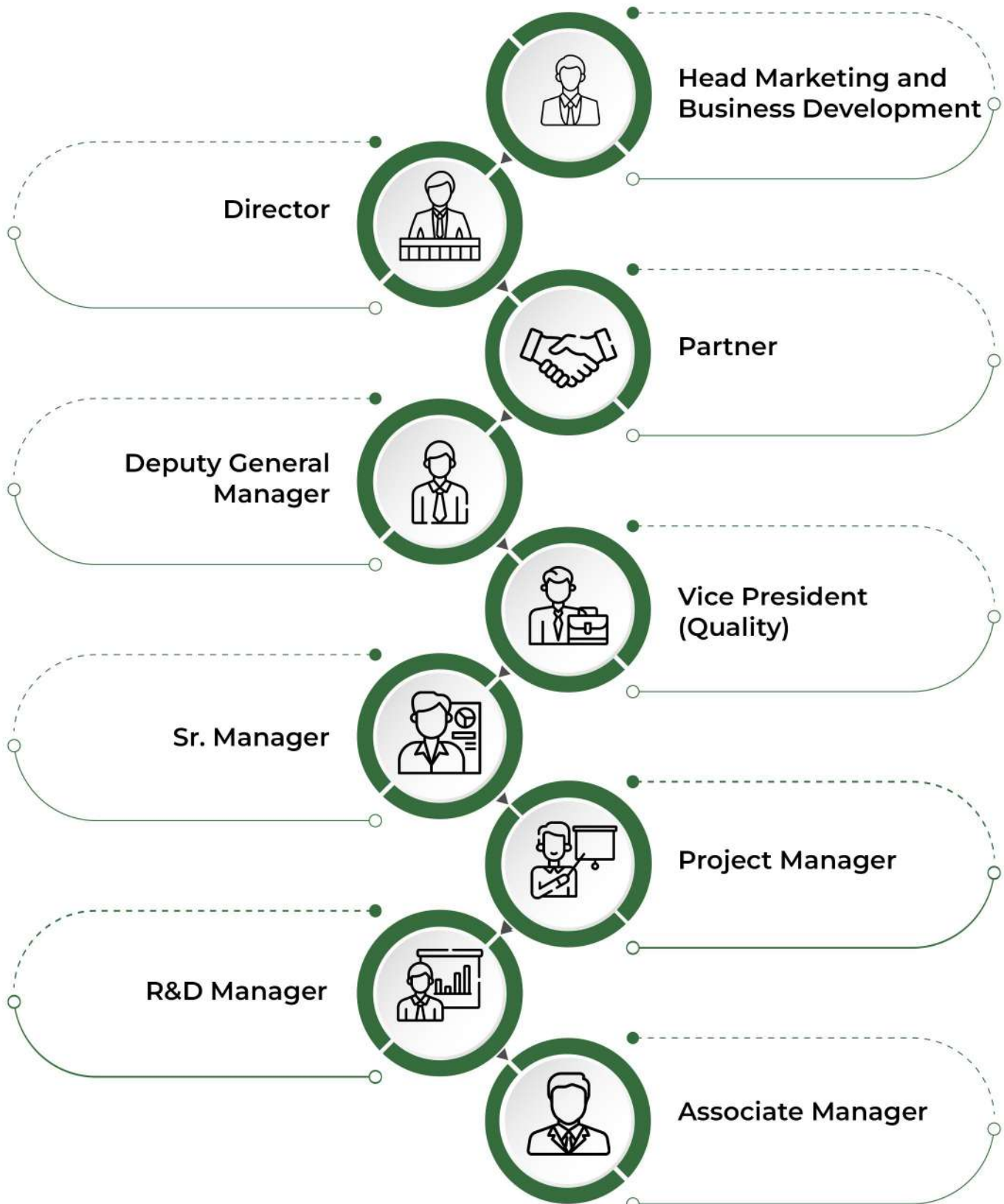
# Profile of Previous Batches



## Note:

- All company names are trademarks or registered trademarks of their respective holders. Use of them does not imply any affiliation with or endorsement by them.
- This only indicates the organizations where participants were employed.
- The list is partial.

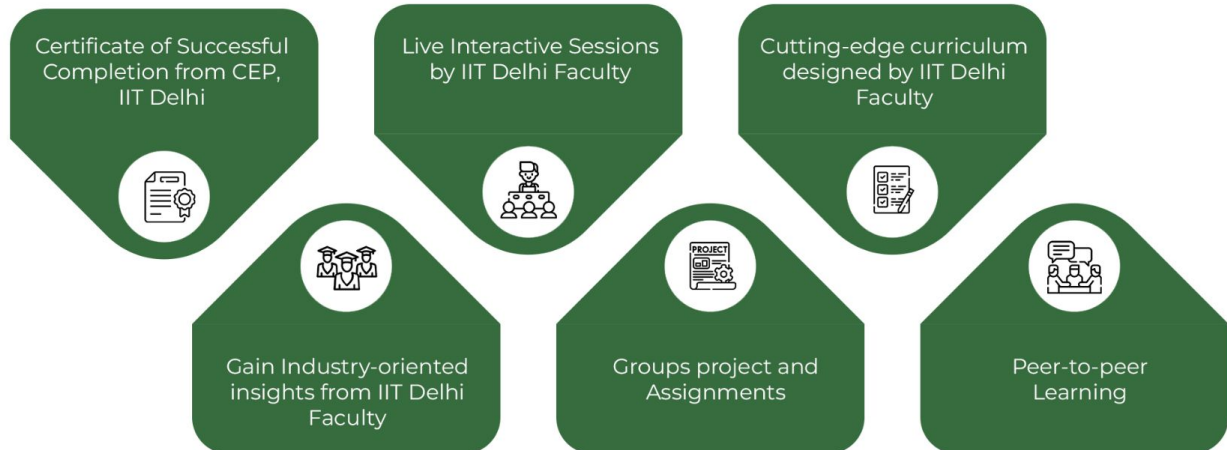
# Designation/Role of Previous Participants



**Note:**

- This only indicates the designation and profiles where participants were employed.
- The list is partial.

# Programme Highlights



# Key Learning Outcomes

- Exposure to full spectrum of technologies, economic and policy aspects of e-mobility space
- Vehicle dynamics
- Comprehensive understanding of storage devices from single cell to pack level
- Lithium ion battery failure mechanisms and testing
- Working principles of traction motors
- Understanding Battery Management System (BMS) architecture
- Power electronics required for drivetrains and chargers
- Charging aspect from device to electric grid level
- Charger types, charging protocols and standards

# Who Should Attend ?

- ▶ Fresh graduates who aspire to work in the sunrise sector of Electric Vehicle (EV) to get a comprehensive overview of the technology.
- ▶ Working professionals in R&D at entry level to get a thorough understanding of the fundamental principles behind the working of energy storage devices and the interface with power electronics, thereby understanding the new possibilities and research directions.
- ▶ At mid and senior level to refresh the underpinning principles behind the energy storage technology and relate it to future trends in the technology.
- ▶ Working professionals at all levels in quality control to get exposure on the relation between the quality specifications and working of the devices at the fundamental level.
- ▶ Production, sales & support to understand the terminologies related to rating, sizing and specifications of the relevant technologies such as energy storage devices, chargers, power electronic components, and powertrain drives.
- ▶ Management and decision making roles to familiarise with the jargons related to Electric Vehicle (EV) technology and get a comprehensive view of the possibilities and limitations of fast changing technologies in the Electric Vehicle (EV) domain.





# Programme Content

## Module 1- Overview of Electric Vehicle

This module will provide the background and overview of the programme learning. It will introduce the need for electric vehicles, classification of electric vehicles, understanding of electric drivetrain, etc.

- ◆ Outlook for EV and the Indian scenario
- ◆ Basic scheme of EV drivetrain
- ◆ Vehicle dynamics and concept of drive cycles

## Module 2- Electrochemical Cells

This module is designed to provide a relevant and holistic view of the various terminologies and fundamentals of any electrochemical device.

- ◆ Electrochemical cell and battery
- ◆ Influence of battery on EV range and cost
- ◆ Type of batteries used in EV
- ◆ Other electrochemical storage relevant to EV: fuel cell, supercap, flow battery

## Module 3- Battery Characteristics

Module will cover the battery types relevant to EV, their key performance indicators and present state-of-art as well as future direction.

- ◆ Battery state and rate of discharge: SoC, SoH, C-rate
- ◆ Key characteristics of Battery: Voltage, current-voltage characteristics
- ◆ Li-ion battery: present state of the art and future directions
- ◆ Li-ion battery failure mechanisms and testing

## Module 4- Cell to Battery Module and Pack

The understanding gained from module 3 will be used for designing and building of module and packs from the cells for real application.

- ◆ Li-ion cell manufacturing process
- ◆ Sizing of battery pack
- ◆ Mechanical and thermal design of battery pack

# Programme Content

## Module 5- Power Electronics Interface

The charge discharge of the battery pack requires matching of its characteristics with the charger and drivetrain characteristics. This matching is through power electronics devices and this learning module will provide relevant background to power electronics required to understand the design and working of power electronics interface.

- ◆ Voltage and current levels in EV
- ◆ Power electronics interface – components and devices
- ◆ Traction motors and their characteristics
- ◆ Convertors and invertors
- ◆ Battery Management System (BMS)
- ◆ Power train architecture

## Module 6- EV Chargers

The success of the electric vehicle will depend on the suitable charging infrastructure. The module will cover the relevant details related to chargers as well as smart and mini-grids, etc.

- ◆ EV charging levels
- ◆ Charger types and standards
- ◆ EV chargers – signalling and communication
- ◆ EV charging techniques

Campus immersion after program completion (optional)

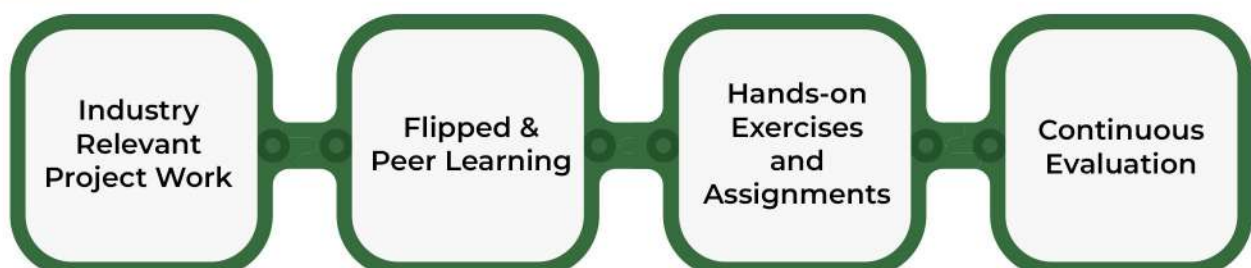
## Module 7- Overview of Policies

This module will discuss various government policies relevant to electric vehicles.

- ◆ EV Indian scenario and future projections
- ◆ Total cost of ownership
- ◆ Indian EV policies

Note: This is an indicative list of course topics and is subject to change as per IIT Delhi's discretion.

## Pedagogy



## Programme Details

<b>Duration</b>	<ul style="list-style-type: none"><li>• 6 Months   75+ Total Contact Hours of Learning</li></ul>
<b>Delivery</b>	<ul style="list-style-type: none"><li>• Live Online</li></ul>
<b>Schedule</b>	<ul style="list-style-type: none"><li>• Session Timings: Sunday   9:30 AM to 12:30 PM</li><li>• Commencement Date: 19<sup>th</sup> November 2023</li><li>• Application Closure Date: 10<sup>th</sup> November 2023</li></ul>
<b>Eligibility</b>	<ul style="list-style-type: none"><li>• For Indian Participants - Graduates or Diploma Holders from a recognised University/Institutes(UGC/AICTE/DEC/AIU/State Government) in any discipline.</li><li>• For International Participants - Graduation or equivalent degree from any recognised University or Institution in their respective country.</li></ul>
<b>Screening &amp; Selection</b>	<ul style="list-style-type: none"><li>• Screening and selection will be done by IIT Delhi.</li></ul>

**Apply Now**



# Programme Fee Details

Fee Structure	
Particulars	Amount
Total Programme Fee	INR 1,10,000/- + 18% GST

Instalment Pattern		
Particulars	Amount	Payment Schedule
Instalment 1	INR 55,000/- + GST	Within 3 days of the issue of Offer Letter
Instalment 2	INR 55,000/- + GST	

## Easy EMI Options Available

**Note:**

- Payment of fees should be submitted in the IIT Delhi CEP account only and the receipt will be issued by the IIT Delhi CEP account for your records.
- Loan and EMI Options are services offered by Jaro Education. IIT Delhi is not responsible for the same.



# Programme Certification

- Complete all the course requirements successfully to obtain this prestigious recognition from IIT Delhi.
- You will be awarded a 'Certificate of Successful Completion', if you obtain 50% aggregate marks in the evaluation components and maintain a minimum attendance of 50% in lectures.
- Participants who are unable to score 50% marks in the evaluation will be eligible for the 'Participation Certificate' if their attendance is above 50%.



The image shows a template for a participation certificate from IIT Delhi. It features the IIT Delhi logo and name at the top, followed by the department and programme details. The text states that the participant has participated in an online certificate programme. There are three signature lines for the Programme Coordinator, Head of the Department, and Head/Associate Head, QIP/CEP. A QR code is located at the bottom center. The footer includes the text 'An initiative under eVIDYA@IITD (ई-विद्या@IITD)'.

Programme Code: \_\_\_\_\_

 **Indian Institute of Technology Delhi**  
HAUZ KHAS, NEW DELHI- 110016

**Department/Centre/School of .....**

**Continuing Education Programme**  
**On**  
**Title of the Programme**

This is to certify that

Mr./Ms. Name Of The Participant

has participated in the online certificate programme on "Title of the Programme" held from ..... to ..... by the Indian Institute of Technology Delhi.

Prof. Programme Coordinator

Prof. Head of the Department

Prof. Head/Associate Head, QIP/CEP

An initiative under eVIDYA@IITD (ई-विद्या@IITD)



The image shows a template for a successful completion certificate from IIT Delhi. It features the IIT Delhi logo and name at the top, followed by the department and programme details. The text states that the participant has successfully completed the online certificate programme. There are three signature lines for the Programme Coordinator, Head of the Department, and Head/Associate Head, QIP/CEP. A QR code is located at the bottom center. The footer includes the text 'An initiative under eVIDYA@IITD (ई-विद्या@IITD)'.

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- The above e-certificate is for illustrative purposes only and the format of the certificate may be changed at the discretion of IIT Delhi.
- Only e-certificate will be provided and it will be issued by CEP, IIT Delhi.
- The organising department of this programme is the Department of Chemical Engineering, IIT Delhi.



## Dr. Anil Verma

Professor  
Department of Chemical Engineering,  
Indian Institute of Technology Delhi

Dr. Anil Verma is a Professor in the Department of Chemical Engineering, IIT Delhi. In addition, Prof. Verma was also a Visiting Professor at Energy, Environmental & Chemical Engineering, Washington University in St Louis, USA and Visiting Fellow at Department of Chemical Engineering, Newcastle University, Newcastle upon Tyne, UK. He is also Principal Investigator and Administrator of DST-IIT Delhi Centre for Energy Storage Platform on Batteries (ESPOB) funded by the Department of Science and Technology, Ministry of Science and Technology, Govt. of India. He is also an active Professorial Member in Centre for Automotive Research and Tribology (CART), IIT Delhi. Prof. Verma holds B.Tech. and M.Tech. (Silver Medal) from H.B.T.I. Kanpur. Prof. Verma served in industry also before doing Ph.D. from IIT Delhi. He is also associated with various IITs, NITs, State Engineering Colleges, IOCL, BIS, DST, etc. in various capacities.

Prof. Verma has successfully completed several Projects and Consultancies for various National and International organisations such as DST; CSIR; BRNS; ISRO; LG; Cenovus, Canada, etc. He has also done many CEP programmes such as Electrochemical Energy Devices; Advanced Pedagogies: Electric Vehicle Theme. Prof. Verma mainly works in the area of Electrochemical systems like Fuel Cells for Portable Devices and Batteries for Energy Storage and Electric Vehicle Charging Station. His research group comprises Chemists, Physicists, Chemical Engineers, Mechanical Engineers, Electrical, Electronics, communication and Instrumentation Engineers. Prof. Verma has supervised 12 Ph.D. theses and presently 6 Ph.D. students are pursuing Ph.D. under him. He has filed 9 National and International patents, out of which 3 have been granted. He has published 3 Monographs, 6 Book Chapters and published 85 Research Papers in high quality International Peer Reviewed Journals. Moreover, he has presented his research work in more than 150 National and International Conferences.



## Dr. Anupam Shukla

Professor  
Department of Chemical Engineering,  
Indian Institute of Technology Delhi

Dr. Anupam Shukla is a Professor in the Department of Chemical Engineering, IIT Delhi and has been a faculty member of IIT Delhi for the last 15 years. Prof. Shukla completed 5 Year Integrated M. Tech. in Chemical Engineering from IIT Bombay and Ph.D. from IIT Kanpur. He then worked as a faculty member at IIT Guwahati for a little more than 2 years before moving to IIT Delhi. Prof. Shukla works in the area of electrochemical systems with focus on electrochemical energy storage, mainly supercapacitors and batteries. The area of interest also includes membrane electrolysis, electrodialysis, electrochemical route to graphene synthesis, and ion exchange membranes.

Prof. Shukla served as a member of curriculum development for post-graduate programme on E-mobility hosted by Centre for Automobile Research (CART) at IIT Delhi and has also served in a few committees of funding agencies to review proposals for support funding for setting up plants on new electrochemical technologies. Prof. Shukla has completed more than 10 projects sponsored by Government funding agencies and Industries on materials and cells related to electrochemical systems and has several ongoing sponsored projects. Prof. Shukla has supervised 7 Ph.D. theses and currently has 5 Ph.D. students working in different areas of electrochemical energy storage. He has published 50 papers in international journals and several in conference proceedings.



## **Dr. Sumit Kumar Pramanick**

Assistant Professor  
Department of Electrical Engineering,  
Indian Institute of Technology Delhi

Dr. Sumit Kumar Pramanick is working as an Assistant Professor in the Department of Electrical Engineering, IIT Delhi. His area of expertise is in the field of design of power electronic converters and its control for applications like machine drives, renewable energy and e-mobility. His research group in IIT Delhi is currently working towards development of high power density power converters for EV battery charging using energy efficient power devices, high bandwidth embedded current sensors, high frequency magnetics design, and wireless power transfer technology. Dr. Pramanick is closely working with a few start-ups in the NCR region to develop products related to power electronics. He has introduced concepts of adaptation of digital controllers in standalone power electronic converters as per industry practice. Separate hands on module has also been developed as a part of the M.Tech. curriculum with Power Electronics and Machine Drives specialisation in IIT Delhi. His contributions to this curriculum was recognized through Teaching Excellence Awards, 2018 in IIT Delhi. He is a recipient of INAE Young Engineer Award, 2020.

He is a Member of IEEE, IEEE Industrial Electronics Society, and IEEE Power Electronics Society. He is a regular reviewer in reputed journals like IEEE Transactions on Industrial Electronics, IEEE Transactions on Power Electronics, IEEE Transactions on Industrial Applications and Sadhana. Prior to joining IIT Delhi, he was a Post Doctoral Fellow in the Cullen College of Engineering at University of Houston, Texas, USA. He finished his doctoral research in the Department of Electronic Systems Engineering, Indian Institute of Science, Bangalore. He completed B.E. in Electrical Engineering from the Indian Institute of Engineering Science and Technology, Shibpur.



## **Dr. Akhil Garg**

Associate Professor  
School of Mechanical Science and Engineering,  
VinUniversity, Vietnam

Akhil Garg is currently working as an Associate Professor in School of Mechanical Science and Engineering in Key Laboratory of New Energy Vehicles in VinUniversity, Vietnam. He was Assistant Professor at IIT, Delhi in Centre for Automotive Research and Tribology. His main research interests include Renewable energy and energy storage systems, Recycling of Battery Pack for EVs, Thermal designs of battery packs, Intelligent Optimization for Engineering design. He has published around 50 papers in this field in reputed International Journals and is currently a Regional Editor of International Journal of Ambient Energy and International Journal of Green Energy.

Note: This is an indicative list of resource faculty.

# About IIT Delhi



as per NIRF India  
Engineering Rankings (2023)



as per ARIIA  
Ranking (2021)



QS World University Rankings  
2023: Engineering & Technology

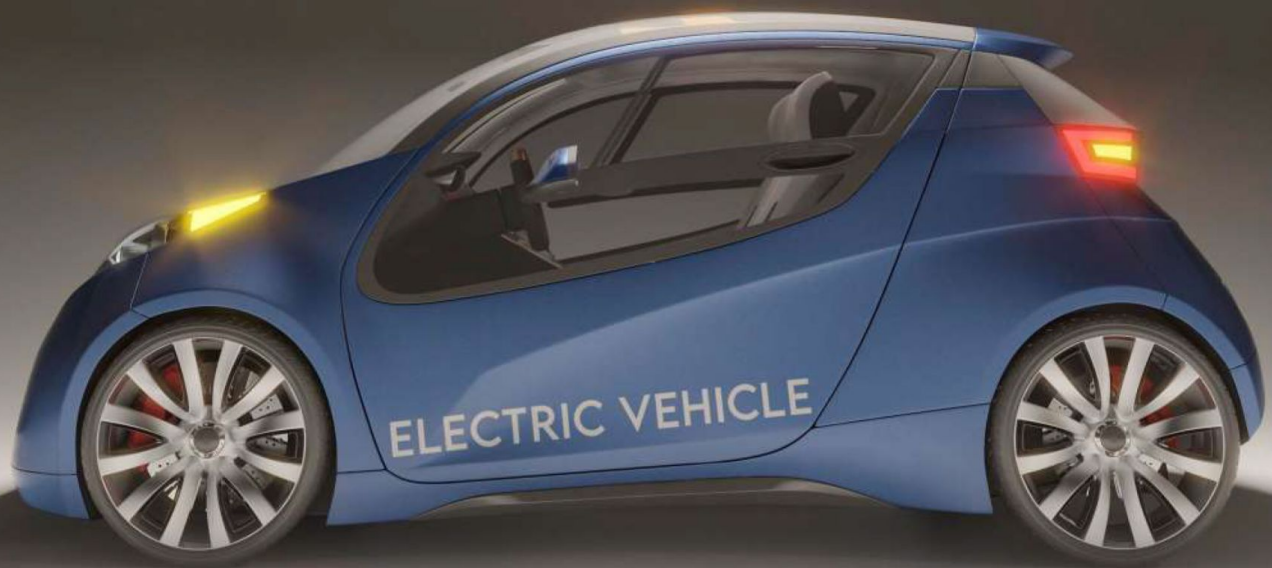
Indian Institute of Technology Delhi is one of the Twenty-Three IITs created to be Centres of Excellence for Training, Research and Development in Science, Engineering and Technology in India. Established as College of Engineering in 1961, the Institute was later declared as an Institution of National Importance under the "Institutes of Technology (Amendment) Act, 1963" and was renamed as "Indian Institute of Technology Delhi". It was then accorded the status of a Deemed University with powers to decide its own academic policy, to conduct its own examinations, and to award its own degrees. Since its inception, over 48000 have graduated from IIT Delhi in various disciplines including engineering, physical sciences, management and humanities & social sciences of these, nearly 5070 received PhD Degrees. The number of students who graduated with B.Tech Degrees is over 15738. The rest obtained Master's Degrees in engineering, sciences and business administration. These alumni today work as scientists, technologists, business managers and entrepreneurs. There are several alumni who have moved away from their original disciplines and have taken to administrative services, active politics or are with NGOs. In doing so, they have contributed significantly to building of this nation and to industrialisation around the world. For more details, please visit: [www.iitd.ac.in](http://www.iitd.ac.in)

## About Continuing Education Programme (CEP)

Executive education is a vital need for companies to build a culture that promotes newer technologies and solutions and builds a workforce that stays abreast of the rapidly transforming needs to the technological, business and regulatory landscape. Committed to the cause of making quality education accessible to all, IIT Delhi has launched Online Certificate Programmes under eVIDYA@IITD (ई-विद्या@IITD): enabling Virtual & Interactive-learning for Driving Youth Advancement@IITD for Indian as well as international participants. These outreach programmes offered by the Indian Institute of Technology Delhi (IIT Delhi) are designed to cater to the training and development needs of various organisations, industries, society and individual participants at national and international level with a vision to empower thousands of young learners by imparting high-quality Online Certificate Programmes in cutting-edge areas for their career advancement in different domains of engineering, technology, science, humanities and management.









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**Anand Krishnan**  
**Jaro Programme Expert**

 **9043001261**

 **an@jaro.in**

**For any feedback, please write to  
CEP IIT Delhi at  
[contactcep@admin.iitd.ac.in](mailto:contactcep@admin.iitd.ac.in)**

Online Certificate Programmes are offered by the Indian Institute of Technology Delhi under the aegis of Continuing Education Programme (CEP) so that the Institute can realise its vision of serving as a valuable resource for industry and society, and fulfil its mission to develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.