

# Post Graduate Program in **ELECTRIC VEHICLE POWERTRAIN**

Get the whole picture



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# About ISIEINDIA

*With more than 1 Million+ learners in 20+ countries, ISIEINDIA, is a leading global edtech company for professional and higher education offering industry-relevant programs in blended and purely online modes across technology domains. Our Programs are Industry oriented to enhance the technical skill sets and to create a sustainable career path for learners.*

## *Enabling career success in the Automotive Industry*

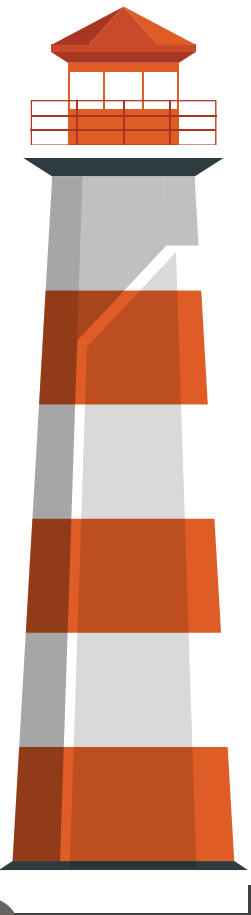
### **Our Mission**

*As India's largest professionals and engineering students learning company and a global footprint in 20+ countries, we're on a mission to make professionals around the globe proficient and future-ready.*

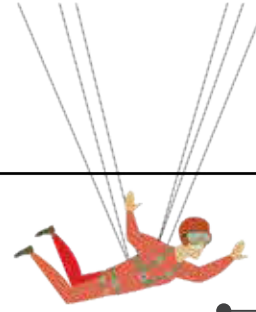
## *A world with skilled automotive ecosystem*

### **Our Vision**

*To create sustainable training platform leading to provide an opportunity to the every member of automotive workforce.*



03



**250+**  
City Learner Base

# Why ISIEINDIA

**300%**  
Highest Salary Hike



**60%**  
Average Salary Hike



**300+**  
Hiring Partners



**1+ Million**  
Learners



**350+**  
Industry Experts



# Program Highlights

## Equivalent to NSQF (National Skill Qualification Framework) Level 6

Do a PG Program from Plugin UP that satisfies NSQF Level 6 criteria.

## Post Graduate Program in Electric Powertrain

Get Certified by ASDC and gain successful completion of the program

## Learn Key Tools & Technologies

Learn Simulink, MATLAB, ANSYS Maxwell, etc.

## Blended Learning

Learn with the ease and flexibility of recorded as well as live session, designed to ensure a wholesome learning experience.

## Weekly Live Mentorship Sessions

## Project Based Learning

Dedicated support for Comprehensive projects that you can showcase in your resume

# Faculty and Industry Experts



**G Leela Mohan Rao**  
Associate Software Engineer

**accenture**



**Boris Fabris**  
Automotive Design Consultant



**Priya Parameswarappa**  
Buisness System Manager

**SIEMENS**



**Manish Kumar**  
Assistant Manager, R&D

**TVS**



**Rahul Bollini**  
R&D Consultant for Li-Ion Battery

**ISI INDIA**  
IMPERIAL SOCIETY OF INNOVATIVE ENGINEERS



**Ketan Kumar Jangra**  
Assistant Manager

**JBM Group**



# ISIEINDIA Learning Experience

## Student Support Team

- We have a dedicated Learner Support Team for handling your queries via email or callback request.
- This support is available from Mon to Sat between 09:00 AM to 07:00 PM

## Expert Feedback

- Personalized expert feedback on assignments and projects
- Regular live sessions by experts to clarify concept related doubts

## Industry Networking

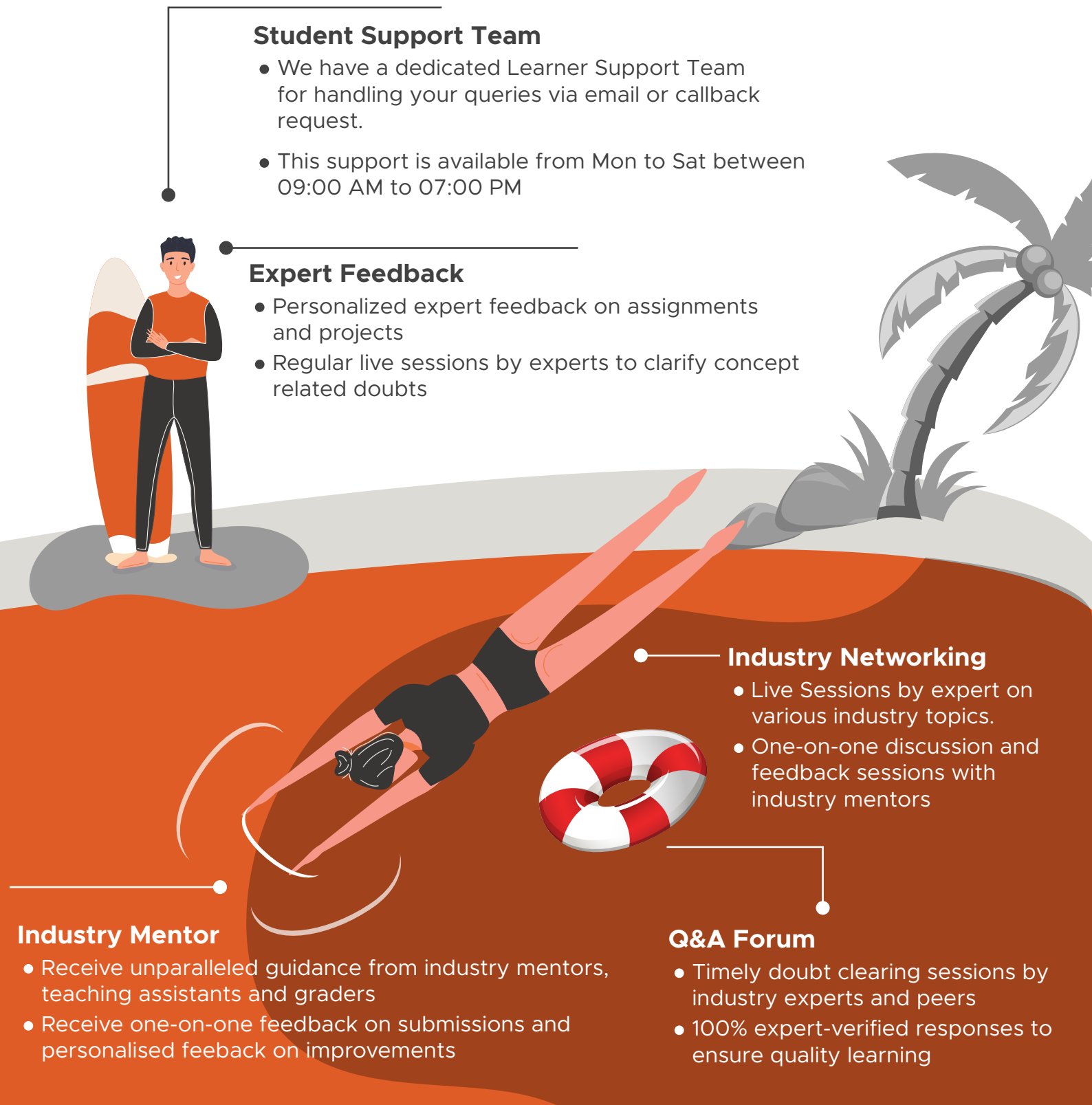
- Live Sessions by expert on various industry topics.
- One-on-one discussion and feedback sessions with industry mentors

## Industry Mentor

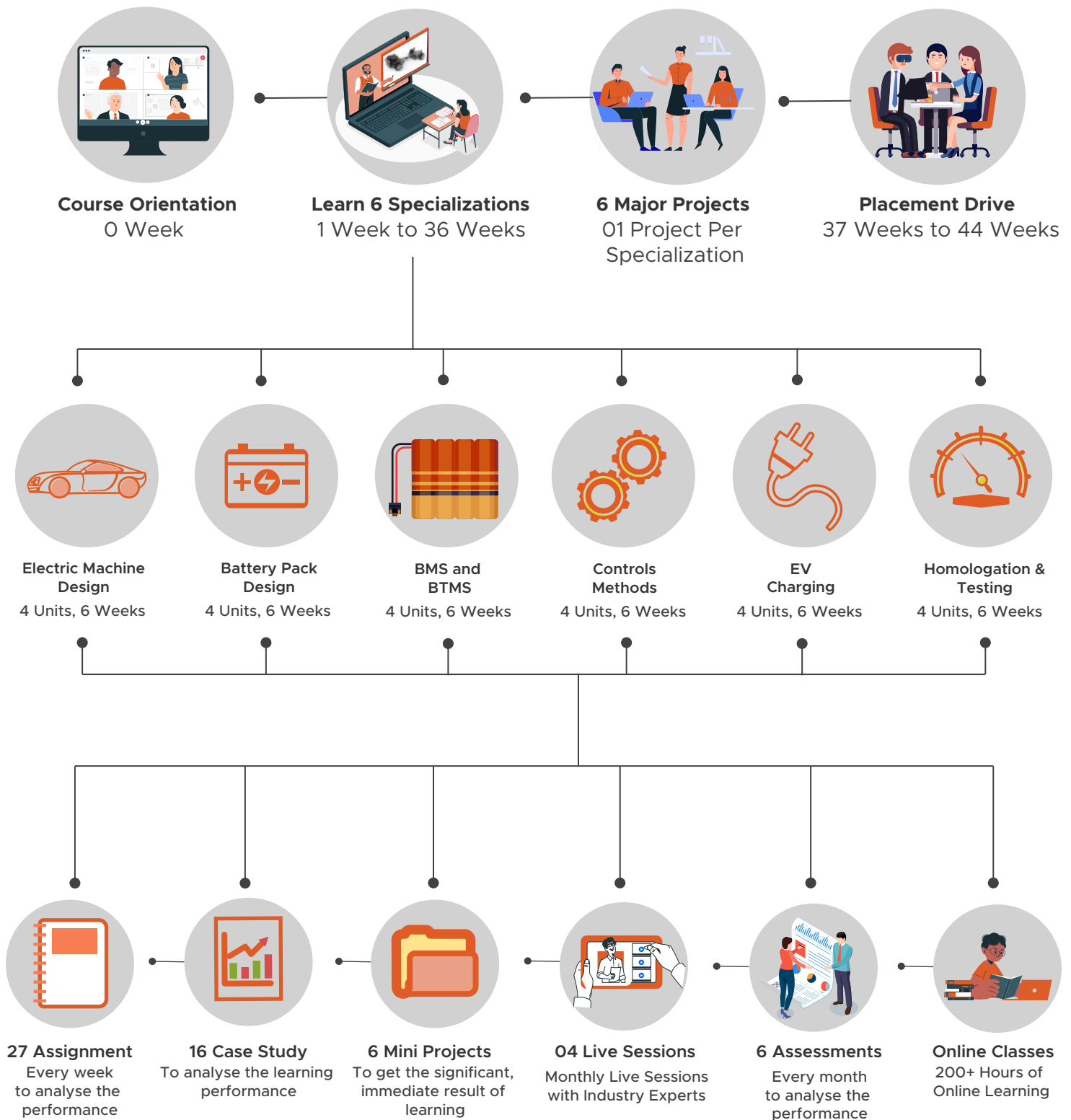
- Receive unparalleled guidance from industry mentors, teaching assistants and graders
- Receive one-on-one feedback on submissions and personalised feedback on improvements

## Q&A Forum

- Timely doubt clearing sessions by industry experts and peers
- 100% expert-verified responses to ensure quality learning



# Learning Path





# Post Graduate Program in EV Powertrain

## COURSE CURRICULUM

### MODULE 1 : ELECTRIC MACHINE DESIGN & INDUSTRY PROSPECTS

#### UNIT 1. ABOUT EV INDUSTRY AND MARKET STUDY

1. Coming of EV in 19th Century
2. Golden Era of EV
3. Coming of New Era in EV
4. EV Market and Sales
5. Components; Trends and Growth
6. HEV Architecture – Parallel Hybrid
7. Series Hybrid
8. Series Parallel
9. Fuel Cell EV
10. Selection on Motors, their Size and Types
11. Transmissions
12. Hub Motor
13. Battery Performance Index : Battery
14. Expert Lecture (Live)

**1 WEEK**

## UNIT 2. ELECTRIC VEHICLE POWERTRAIN SELECTION

1. Vehicle Coordinate System
2. Powertrain Equation
3. Drag Equation
4. Drag Coefficient
5. Drag Calculation
6. Tire Construction and Specification
7. Wheel Rolling without Slipping
8. Wheel Dynamics ROLL vs SLIP vs SKID
9. Contact Patch
10. Hysteresis Loss
11. Tyre Parameters
12. 2W – Calculating Parameters
13. Power Calculation
14. Torque Calculation
15. Gearbox Selection
16. Motor Characteristics
17. Expert Lecture (Live)

**1 WEEK**

## UNIT 3. MOTOR AND CONTROLLER

1. Vehicle Coordinate System
2. Basic Understanding of Motor
3. SRM Motor
4. Introduction of BLDC Motor
5. Control Principles
6. Motor for EV
7. Regenerative Braking

**4 DAYS**

- 8. Motor Control
- 9. Motor Control Quadrant
- 10. Asynchronous vs Synchronous Motor
- 11. Expert Lecture (Live)

3 DAYS

## UNIT 4. MOTOR MODELLING AND DESIGN

- 1. Introduction
- 2. Motor Geometry
- 3. Add Winding and Material
- 4. Simulating E Magnetics
- 5. Expert Lecture (Live)

1 WEEK

## PROJECT 1 : BLDC MOTOR DESIGN

By using Motor-Cad Software Design Tools , Design & submit 2D Axial & Radial Motor with Specific Stator, Rotor, Winding Pattern , Winding Material Parameters. And Draw Torque , Back Emf, current losses , BH Steel Curves for the same

2 WEEK

## MODULE 2 : LITHIUM ION CELL AND BATTERY PACK DESIGN

### UNIT 1. INTRODUCTION TO LITHIUM-ION CELLS

- 1. Working principle of a Lithium-Ion Cell
- 2. History of Lithium-Ion Cells
- 3. Various chemistries of Lithium-Ion Cells
- 4. Various form factors of Lithium-Ion Cells
- 5. NMC Cells and its Applications

4 DAYS

6. LFP Cells and its Applications
7. Components of a Lithium-Ion Cell
8. Fabrication process of a Lithium-Ion Cell
9. SEI Layer Formation

**3 DAYS**

## **UNIT 2. CHARACTERISTICS OF A LITHIUM ION CELL**

1. What is a cell capacity and its units?
2. How to measure the cell capacity?
3. Popular cell capacities used in India
4. Definition of nominal voltage and values for popular cell chemistries
5. Definition of upper cut-off voltage and values for popular cell chemistries.
6. Definition of lower cut-off voltage and values for popular cell chemistries.
7. Open circuit voltage (OCV) and its importance in cell sorting.
8. Definition of cell internal resistance
9. Understanding its values
10. How to measure cell internal resistance?
11. Importance of cell internal resistance in cell sorting.
12. Definition of state of charge
13. Importance of state of charge during cell sorting
14. Definition of state of health
15. Capacity fade property of a Lithium-ion cell
16. How to measure state of health?
17. Gravimetric energy density and its calculation
18. Volumetric energy density and its calculation

**1 WEEK**

## UNIT 3. LITHIUM ION CELL OPERATION

1. Storage for up to 3 months, 3-6 months and above 6 months
2. Temperature range during charging for NMC and LFP
3. Temperature range during discharging for NMC and LFP
4. What is a C rating?
5. Standard continuous charge current
6. Maximum continuous charge current
7. Standard continuous discharge current
8. Maximum continuous discharge current
9. Peak current
10. Definition of cycle life
11. Factors affecting cycle life
12. Major components of a battery pack
13. Expert Lecture (Live)

**1 WEEK**

## UNIT 4. INTRODUCTION TO BATTERY PACK

1. Packaging components and its importance
2. Series and parallel arrangement of cells
3. Connecting a BMS to the battery pack
4. Master-slave BMS and its connection
5. Types of connectors
6. Selecting the right Lithium-ion cell
7. Selecting the right BMS
8. Types of bonding materials and selecting the right thickness
9. Selecting the right rating of connectors
10. Expert Lecture (Live)

**1 WEEK**

## UNIT 5. INTRODUCTION TO BATTERY PACK

1. Energy auditing the end application
2. Discharge capacity testing
3. Depth of discharge (DoD) testing
4. Vibration test
5. Mechanical drop test
6. Ingress protection rating testing
7. External short circuit protection
8. Over-charge protection
9. Over-discharge protection
10. Over-temperature protection
11. Expert Lecture (Live)

**4 DAYS**

## UNIT 6. BATTERY PACK DESIGN

1. Process of making a battery pack with illustration
2. Ideal design techniques : Welding types & its usage, BMS parameters, Thermal management
3. Expert Lecture (Live)

**3 DAYS**

## PROJECT 2 : CAD MODELING OF DIFFERENT BATTERY PACKS

Designing battery packs with different cell compositions and suggesting different CAD models for each cell chemistry. Calculation of number of cells in a battery pack.

**2 WEEK**

## MODULE 3 : BMS AND BTMS

### UNIT 1. INTRODUCTION TO BMS

1. Definition of a BMS
2. Monitoring
3. Predefined operating conditions
4. Mandate from cell manufacturers
5. Create a safe environment for batteries
6. Hardware BMS
7. Smart BMS
8. Overvoltage cut-off
9. Undervoltage cut-off
10. Continuous current
11. Over current detection
12. Temperature cut-off
13. Why communication is important?
14. Analysing the data
15. Types of communication protocols
16. State of charge (SoC)
17. Depth of discharge (DoD)
18. State of health (SoH)
19. State of power (SoP)
20. Energy delivered since last charge
21. Number of charge-discharge cycles
22. Total energy delivered since first use
23. Total operating time since first use
24. Expert Lecture (Live)

**1 WEEK**

## UNIT 2. BMS IN LITHIUM ION BATTERY

1. Active and passive components in a BMS
2. Explanation of BMS architecture design
3. How to connect the BMS in a battery pack
4. How to connect the BMS to the individual cells for balancing
5. For NMC Battery pack applications
6. For LFP Battery pack applications
7. What is balancing?
8. How does the BMS do the balancing?
9. Passive balancing
10. Active balancing
11. Expert Lecture (Live)

**1 WEEK**

## UNIT 3. BMS FAILURE ON FIELD, TESTING

1. Common reasons for failure
2. How to avoid failures
3. Indian manufacturers
4. Foreign manufacturers
5. BMS passes the test
6. BMS fails the test and reasons behind it
7. Expert Lecture (Live)

**4 DAYS**

## UNIT 4. INTRODUCTION TO BTMS AND ITS TYPES

1. Definition
2. Thermal Management of batteries
3. Prevents thermal runaway of batteries

**3 DAYS**



4. Active BTMS
5. Passive BTMS
6. Air cooling
7. Expert Lecture (Live)

**4 DAYS**

## **UNIT 5. BTMS IN LITHIUM ION BATTERIES**

1. Liquid cooling
2. Phase changing materials (PCM)
3. BTMS in existing Indian EVs
4. Future of BTMS
5. R&D scope in BTMS
6. Expert Lecture (Live)

**3 DAYS**

## **PROJECT 3 : PERFORMANCE ESTIMATION OF BATTERY PACK UNDER DIFFERENT DRIVE CYCLE**

Designing the battery pack in MATLAB Simulink and performing simulation for thermal and Different Drive cycles. Estimating the performance and battery life cycle.

**2 WEEK**

## **MODULE 4 : CONTROL METHODS**

### **UNIT 1. FUNDAMENTAL OF POWER ELECTRONICS AND DRIVES**

1. Basics of Power Electronics
2. AC-DC converters
3. DC-DC Converters
4. DC-AC Converters
5. Expert Lecture (Live)

**1 WEEK**

## UNIT 2. INDUCTION MOTOR DRIVES

1. Induction Motor Drive
2. Operation of induction motor with unbalance voltage and Single phasing
3. Analysis of Induction Motor Fed from Non Sinusoidal Supply
4. Starting Methods of Induction Motor
5. Braking in Induction Motors
6. Speed control in Induction Motors
7. Variable Frequency control method of Induction Motor Drive
8. Slip Power Recovery Methods
9. Static Kramer Drive
10. VSI Fed Induction Motor
11. Introduction to CSI fed Induction Motor and its operation.
12. Expert Lecture (Live)

**1 WEEK**

## UNIT 3. BRUSHLESS DC MOTOR DRIVE

1. Synchronous Motors
2. BLDC Motors
3. Control Strategy in BLDC Motor
4. Servo Applications
5. BLDC Motor Drives
6. Expert Lecture (Live)

**1 WEEK**

## UNIT 4. PMSM DRIVES & SWITCHED RELUCTANCE MOTOR DRIVE

1. PMSM Motors
2. Servo Drive employing Sinusoidal PMAC Motor Fed From Current regulated VSI
3. Switched Reluctance Motor
4. Converter circuits in SRM
5. Modes of operation in SRM
6. Expert Lecture (Live)

**1 WEEK**

## PROJECT 4 : DESIGN THE CONTROLLER OF A BLDC MOTOR

Suggest the MATLAB model of a 3 phase BLDC motor and evaluate the performance under different load conditions. Components used while modeling must follow industrial standards and should be available for manufacturing purposes.

**2 WEEK**

## MODULE 5 : EV CHARGING

### UNIT 1. INTRODUCTION TO EV CHARGING

1. Introduction to EVSE
2. Safety of EVSE Infra
3. Sites & Maps
4. Related Technology
5. EV Charging Connector – SAE

**3 DAYS**

6. IEC62196 Connector
7. SAEJ1172
8. Introduction to Bharat AC
9. CHAdeMO Connector
10. Communication Protocol
11. Charging Methods and Algorithm
12. Expert Lecture (Live)

**4 DAYS**

## **UNIT 2. CHARGING PROTOCOL AND MODES**

1. OSI Introduction
2. Layered Architecture 01
3. Layered Architecture 02
4. OCPP and CSMS Introduction
5. Benefits of OCPP
6. SOAP and JSON
7. Functions of OCPP
8. Charger Technologies
9. Intro to Power Electronics Devices
10. Switch Configurations
11. Turn Off Mechanism and Harmonics
12. AC Charging Levels
13. Intro to Charging Levels and Modes
14. DC Charging Levels
15. Charging Modes
16. Charging Modes Case Study
17. Charging Levels and Modes
18. Expert Lecture (Live)

**1 WEEK**

### UNIT 3. CHARGING TYPE

1. Fast Charging Intro
2. Fast Charger Safety
3. DC Charging – Region wise spread
4. DC Connectors
5. Tesla Supercharger
6. Tesla Supercharger Billing and Connectors
7. Mega Chargers
8. Expert Lecture (Live)

**1 WEEK**

### UNIT 4. CHARGING TECHNOLOGIES

1. Introduction to Smart Grid
2. Definitions 01
3. Definitions 02
4. Smart Grid
5. V2G Technology
6. Application of V2G
7. Unidirectional V2G
8. Bidirectional V2G and Efficiency
9. SAE and ISO-IEC Std
10. Signaling Circuit
11. Expert Lecture (Live)

**1 WEEK**

### PROJECT 5 : PROPOSED MODEL OF A CHARGING STATION

Design the setup of a charging station after analyzing the population, number of E vehicles, Load distribution and geological condition of an area.

**2 WEEK**

## MODULE 4 : HOMOLOGATION AND TESTING

### UNIT 1. INTRODUCTION TO REGULATIONS

1. Vehicle Categories
2. BOV vs EV
3. CMVR 1989 and AIS Committee
4. FVSS
5. EEC/ECE
6. Whole Vehicle Type Approval
7. Homologation for Export
8. Type of Test Tracks
9. Hardware in Loop (HIL)
10. Driving Cycle
11. Expert Lecture (Live)

**1 WEEK**

### UNIT 2. STATIC TESTS

1. CMVR Physical Verification
2. Tire Depth
3. Vehicle Weight
4. Horn Installation
5. Rear View Mirror
6. Tell Tales Test
7. External Projection
8. Wheel Guard
9. Foot Control Arrangements
10. Angle and Dimensions Measurement
11. Requirement of Temporary Cabin
12. Expert Lecture (Live)

**1 WEEK**

## UNIT 3. DYNAMIC TESTS

1. Vehicle Preparations
2. Pass-by-Noise
3. Gradeability
4. Instruments Calibration
5. Turning Circle Test
6. Steering Effort
7. Cooling Performance
8. Brake Test
9. Range Test
10. Energy Consumption Test
11. Maximum Speed
12. Acceleration Test
13. Expert Lecture (Live)

**1 WEEK**

## UNIT 4. VEHICLE COMPONENT TESTING & HYBRID VEHICLE RETROFITMENT AND CHARGING

1. Component Testing – Horn Test
2. Safety Glass Test
3. Windscreen Test
4. Rear View Mirror Test
5. Hinges and Latches Test
6. Demist and Defrost Test
7. Field of Vision Test
8. Powertrain Component Test – Motor Power
9. Max 30 minutes power
10. Battery Safety Criteria

**4 DAYS**

11. EMI-EMC
12. Hybrid Vehicle Test – M and N Category
13. Hybrid Retro fitment Kit
14. Electric Kit for Conversion
15. Charging System– AC Charging
16. DC Charging
17. Expert Lecture (Live)

**3 DAYS**

## **PROJECT 6 : 2-W TESTING BY ARAI**

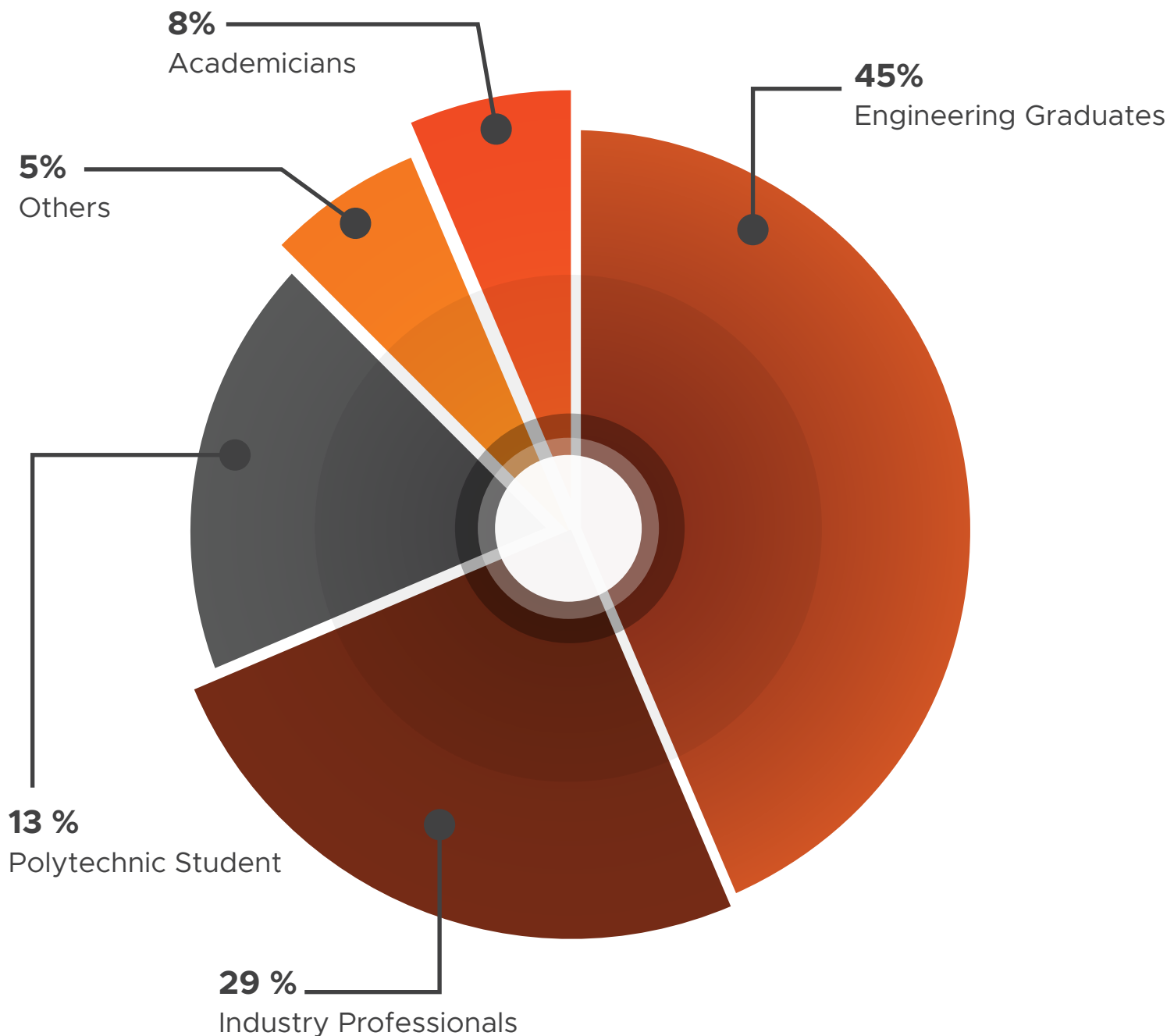
Students will make able to make real time project report on ARAI Testing of 2W EV. Complete process of EV Testing and their expected outcomes.

**2 WEEK**



# Meet the Class

## OUR LEARNER'S COMES FROM



# Career Support

## Interview Preparation

Pre-recorded content on topics such as

- Problem solving approach
- Approaching guesstimates
- Domain specific interview question bank and much more

## Profile Builder

An easy to use Resume, Linedin and Cover Letter preparation tool.

- Resume Score
- Realtime recommendations to improve
- Match your resume to the JD and check fitment
- Linkedin Profile Review

## Industry Readiness Assesments

Industry oriented tests which are pre-pared and validated by domain experts.

- Detailed reports
- Industry readiness score
- Identifying strengths and helping aid in self-improvement plan for key skills

## Career Mentorship Sessions

Get personalised career advice through 1-1 sessions with industry experts

- Goal setting for better employment results
- Industry Readiness Assessment report discussion

## Personalised Industry Session

90-minute sessions over the weekend by leading industry experts

- Session categories: Career, Technical and Communication
- Doubt resolution
- Develop proof of concept and apply theoretical concepts in real world
- Assess skill levels
- Peer Networking
- Classroom element
- Business communication sessions and much more

**1+ Million**  
Learners

**INR 11<sub>LPA</sub>**  
Highest Salary Package

**300%**  
Highest Salary Hike

**60%**  
Average Salary Hike

## Our Alumni's Work's at

ISIEINDIA has a network of over 250+ companies who look to recruit graduates from our programs. Some of these well-known companies include.



# Program Details and Admission Process

## PROGRAM DURATION AND FORMAT

09 Months | Online | Live

## PROGRAM FEES

Starting at INR 4000/month\* or INR 72000/-

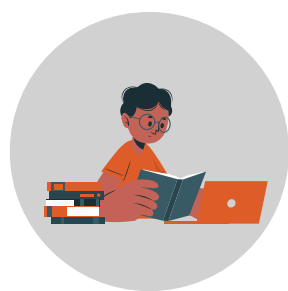
## ELIGIBILITY

Bachelor's Degree with 50% or equivalent passing marks.

## PROGRAM START DATE

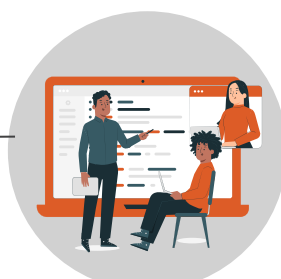
Please refer to the website for program start dates.

## MONTHLY COMMITMENT (31-34 hours/month)



### 20-22 HOURS

Asynchronous learning time



### 7-8 HOURS

Assignments and projects



### 4 Live Session

Once in a week

**FOR FURTHER  
INFORMATION CONTACT**

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## COMPANY INFORMATION

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