

#### Post Graduation Program in

### **ELECTRIC VEHICLE DESIGN**





## Table of Contents

- 2 About ISIEINDIA
- **3** Why ISIEINDIA
- 4 Program Highlights
- 5 Faculty and Industry Experts
- **6** ISIEINDIA Learning Experience
- 7 Learning Path
- **8** Post Graduation Program Curriculam
- **20** Post Graduation Program Projects
- **22** Meet the Class
- 23 Career Support
- 24 Our Alumni Work at
- **25** Program Details



### **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

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

Our Vision

#### A world with skilled automotive ecosystem

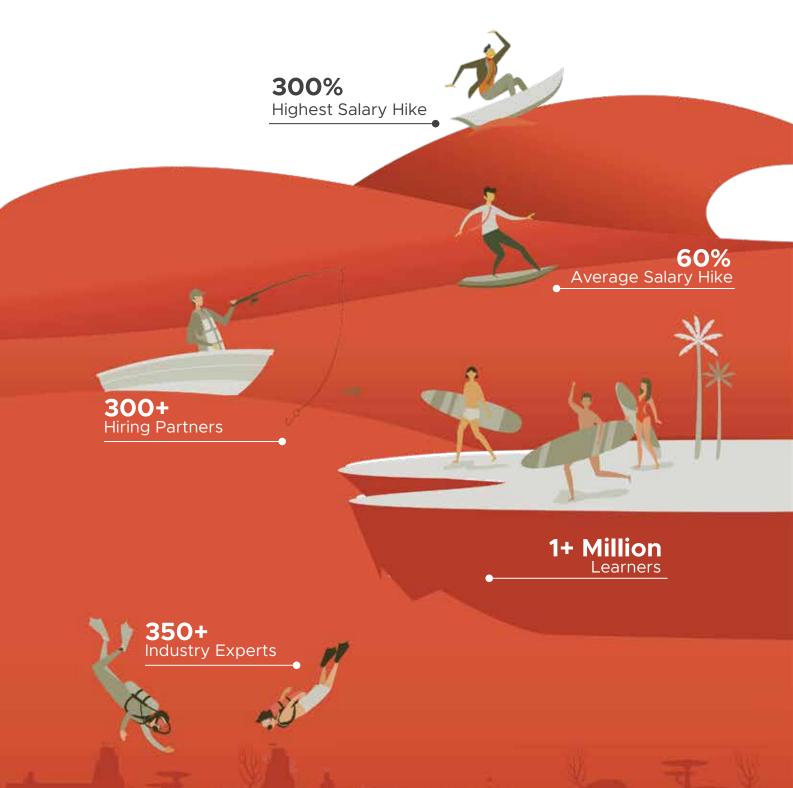
To create sustainable training platform leading to provide an opportunity to the every member of automotive workforce



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## Why ISIEINDIA





## 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 Vehicle Design

Get Certified by ASDC and gain succesfull 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







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



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



**Ketan Kumar Jangra** Assistant Manager











## 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 Monday to Saturday 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**

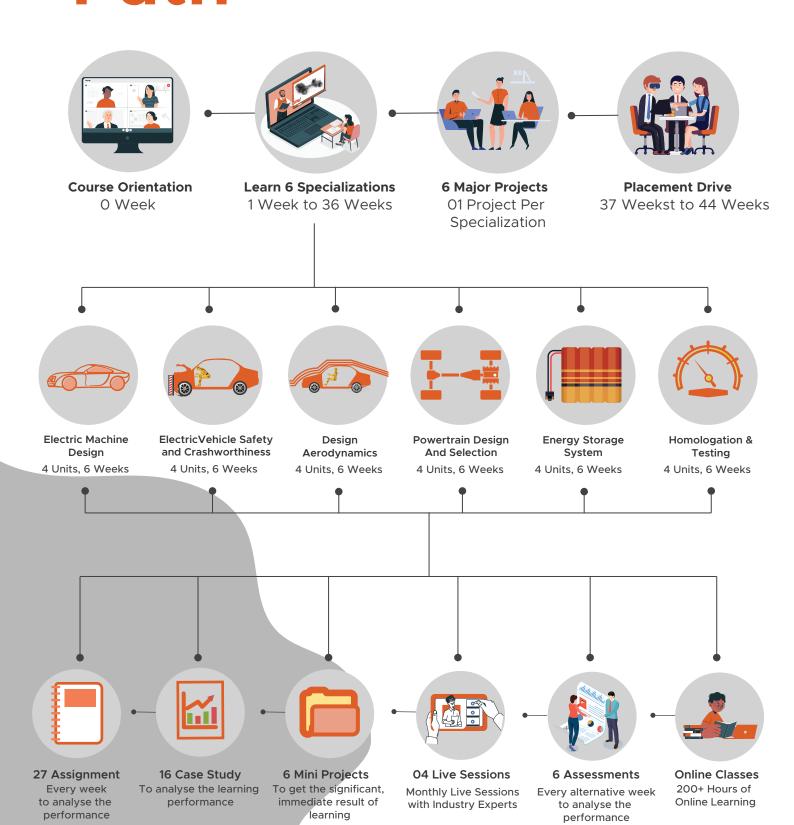
- Receive unparalleled guidance from industry mentors, teaching assistants and graders
- Receive one-on-one feedback on submissions and personalised feeback on improvements

#### **Q&A Forum**

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



## Learning Path





# Post Graduation Program in Electric Vehicle Design 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)



#### **UNIT 2. DESIGNING HOOD**

- 1. Software Interface NX CAD Basics
- 2. NX CAD Curves and Sketches
- 3. NX CAD Surfacing
- 4. NX CAD Assembly
- 5. Surfacing in CATIA
- 6. Hood Design Design Parameters
- 7. Creating Model
- 8. Model Geometry Study Draft Analysis
- 9. Section Modulus
- 10. Fender Design
- 11. Expert Lecture (Live)

#### **UNIT 3. AUTOMOTIVE SAFETY**

- 1. Automobile Safety System Crash Safety
- 2. Roll Over Protection
- 3. Field View Windshield Material
- 4. Windshield Area
- 5. Roof Design Impact Test
- 6. Material Used
- 7. Prepare Master Section
- 8. Expert Lecture (Live)

#### **UNIT 4. DOOR DESIGN**

- 1. Side Doors Body Side
- 2. Side Doors

1 WEEK

1 WEEK

3 DAYS



- 3. Back Door
- 4. Release Drawing Intro to GD
- 5. Drawing Release
- 6. Expert Lecture (Live)

4 DAYS

#### 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: ELECTRIC VEHICLE SAFETY AND CRASHWORTHINESS

#### **UNIT 1. BASIC OF HYPERMESH**

- 1. Basic of FEA
- 2. Introduction to HyperMesh
- 3. Hypermesh UI
- 4. 1D Meshing
- 5. 2D Meshing
- 6. Car Door Handle Meshing
- 7. BIW Arm Meshing
- 8. LH Inboard Cross Member
- 9. Expert Lecture (Live)



#### **UNIT 2. INTRODUCTION TO LS-DYNA**

- 1. Introduction to LS-Prepost
- 2. Create a LS-DYNA input deck for Front Bumper Impact
- 3. LS-DYNA input deck for a ball impacting a plate
- 4. Rear under Run Protection Device of Heavy Vehicle
- 5. Expert Lecture (Live)

1 WEEK

#### **UNIT 3. VEHICLE CRASHWORTHINESS**

- 1. Modal Analysis
- 2. Composite Material Analysis
- 3. Explicit Analysis
- 4. Vehicle Crash Safety
- 5. Occupant Injury Criteria
- 6. Regulations and Global NCAP
- 7. Linear Vs Non Linear
- 8. Static Vs Dynamic
- 9. Expert Lecture (Live)

#### **UNIT 4. SEAT BELT ANALYSIS**

- 1. Seatbelt Anchorage Test
- 2. CG and Seatbelt Component Analysis
- 3. Post Processing of Seatbelt Anchorage Test
- 4. Luggage Retention and H1H2 Tests in Seat
- 5. Head Impact Analysis
- 6. Expert Lecture (Live)

1 WEEK



### PROJECT 2: OPTIMIZE THE DESIGN OF A CHASSIS FOR DIFFERENT DEFORMATION

Propose the different amendments in design of a chassis of a vehicle and perform deformation tests for all the proposed models and choose the most safe design.

2 WEEK

#### **MODULE 3: DESIGN AERODYNAMICS**

#### **UNIT 1. INTRODUCTION**

- 1. Introduction of CFD?
- 2. What is CFD?
- 3. CFD Process
- 4. CFD Pre Requisites
- 5. Introduction to Fluid Dynamics Basics of Flow
- 6. Basic Terminologies
- 7. Aerodynamics Equation
- 8. Area and Drag Coefficient
- 9. Expert Lecture (Live)

#### **UNIT 2. CALCULATING FRONTAL AREA**

- 1. Area Calculation
- 2. Approximation Method
- 3. Expert Lecture (Live)

1 WEEK



#### **UNIT 3. DRAG CALCULATIONS**

- 1. Introduction to FEM
- 2. FEM Processed Geometry Types
- 3. 2D Simulation Geometry
- 4. 2D Simulation Meshing
- 5. Expert Lecture (Live)

#### **UNIT 4. DRAG SIMULATIONS**

- 1. Solver Setup
- 2. 2D Simulation Results
- 3. Finding Drag Coefficient
- 4. 3D Process
- 5. 3D Geometry
- 6. Expert Lecture (Live)

1 WEEK

1 WEEK

#### **PROJECT 3: CFD ANALYSIS OF DIFFERENT 4 WHEELERS**

Perform the CFD analysis of 3 different 4 wheelers available in the market of same segment, perform the changes in current designs and compare the results before and after Design iteration.



#### **MODULE 4: POWERTRAIN DESIGN AND SELECTION**

#### **UNIT 1. INTRODUCTION**

- 1. Vehicle Coordinate System
- 2. Powertrain Equation
- 3. Aero Calculation Drag Equation
- 4. Drag Coefficient
- 5. Drag Calculation
- 6. Expert Lecture (Live)

1 WEEK

#### **UNIT 2. COMPONENT SELECTION**

- 1. Tire Construction and Specification
- 2. Wheel Rolling without Slipping
- 3. Wheel Dynamics ROLL vs SLIP vs SKID
- 4. Contact Patch
- 5. Hysteressis Loss
- 6. Tyre Parameters
- 7. Motor Selection Calculating Parameters
- 8. Power Calculation
- 9. Torque Calculation
- 10. Gearbox Selection
- 11. Motor Characteristics
- 12. Expert Lecture (Live)

#### **UNIT 3. MOTOR**

- 1. PE and Motor Control
- 2. Basic Understanding of Motor
- 3. SRM Motor

1 WEEK

3 DAYS

15-

- 4. Introduction of BLDC Motor
- 5. Control Principles
- 6. Motor for EV
- 7. Regenerative Braking
- 8. Motor Control
- 9. Motor Control Quadrant
- 10. AC Motor Control
- 11. Asynchronous vs Synchronous Motor
- 12. Expert Lecture (Live)

#### **UNIT 4. MOTOR SIMULATION**

- 1. Motor Modelling and Design Introduction
- 2. Motor Geometry
- 3. Add Winding and Material
- 4. Simulating E Magnetics
- 5. Model Based Simulation
- 6. Motor Geometry
- 7. Add Winding and Material
- 8. Expert Lecture (Live)

4 DAYS

1 WEEK

#### PROJECT 4: RETROFITMENT OF A 2 WHEELER

Design the CAD model of a Retrofitted 2 wheeler after performing all the Load calculations.



#### **MODULE 5: ENERGY STORAGE SYSTEM**

#### **UNIT 1. CELL TYPES AND CHARACTERISTICS**

- 1. History of Battery pack
- 2. First rechargeable battery
- 3. Li-ion battery introduction and working
- 4. Comparison of different cells
- 5. Different chemistries in Li-ion cell
- 6. Battery parameter and performance Characteristics
- 7. Battery pack designing and cell calculation
- 8. Why li-ion battery die?
- 9. Sulphation in lead acid battery
- 10. Internal resistance of li-ion battery
- 11. Battery charging protocols
- 12. Self-discharges in Li-ion battery
- 13. FAQ regarding batteries
- 14. Best conditions for operation of batteries
- 15. Expert Lecture (Live)

#### **UNIT 2. BATTERY PACK DESIGN AND CELL SORTING**

- 1. Energy Consumption Calculation
- 2. Calculating Battery Pack Size
- 3. Cell Load Characteristics
- 4. Battery Pack Capacity and Voltage
- 5. Nickel Strip Selection
- 6. Bus Bar Bonding
- 7. Tab Bonding
- 8. Cell to Cell Gap

1 WEEK

3 DAYS

17

- 9. Spot Welding vs Laser Welding
- 10. Performance Design and Safety Layer
- 11. Safety Layer Design
- 12. Cell Assembly Model
- 13. Battery Case Design Principles
- 14. Battery Case Design Model
- 15. Battery Pack Component Packaging
- 16. Expert Lecture (Live)

#### **UNIT 3. BMS DESIGN AND ARCHITECTURE**

- 1. Why BMS
- 2. BMS Functionality
- 3. Sensing Voltage
- 4. Sensing Current
- 5. Sensing Temperature
- 6. High Voltage Contactor
- 7. Isolation Circuit
- 8. Thermal Control
- 9. SOC of Cell
- 10. Energy and Power of Cell
- 11. OCV and SOC of Cell
- 12. Linear Polarization
- 13. Finding RC Values
- 14. Hysteresis Voltage
- 15. Enhanced Self Correcting Model
- 16. Cell Testing and Coulombic Efficiency
- 17. Temperature and OCV
- 18. Matlab Cell Model Simulation

4 DAYS

5 DAYS



- 19. Data Based Cell Simulation
- 20. Physics based Model
- 21. Simulating EV
- 22. Simulating constant power and voltage
- 23. Battery Simulation
- 24. Expert Lecture (Live)

2 DAYS

### UNIT 4. BATTERY THERMAL MANAGEMENT AND ITS SIMULATION

- 1. What is BTMS?
- 2. Types of BTMS
- 3. Heat vs Temperature
- 4. Cell Heat Map (1C and 3C)
- 5. Thermal Paste Cooling
- 6. Phase Changing Material
- 7. Heat Exchanger
- 8. Preliminary Definitions
- 9. Microscale Thermal Model
- 10. Boundary Condition
- 11. Peltier Coefficient
- 12. Transfer of Heat at Boundaries
- 13. Change in Parameter Values
- 14. Gradient Transfer Fnc
- 15. Heat Generation Terms
- 16. Irreversible Heat Generation
- 17. Joule Heating
- 18. Heat Flux Terms
- 19. Expert Lecture (Live)



## PROJECT 5: 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 6: 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)

#### **UNIT 2. STATIC TESTS**

- 1. CMVR Physical Verification
- 2. Tire Depth
- 3. Vehicle Weight

1 WEEK

2 DAYS



- 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)

#### **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)

5 DAYS



### 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
- 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)

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

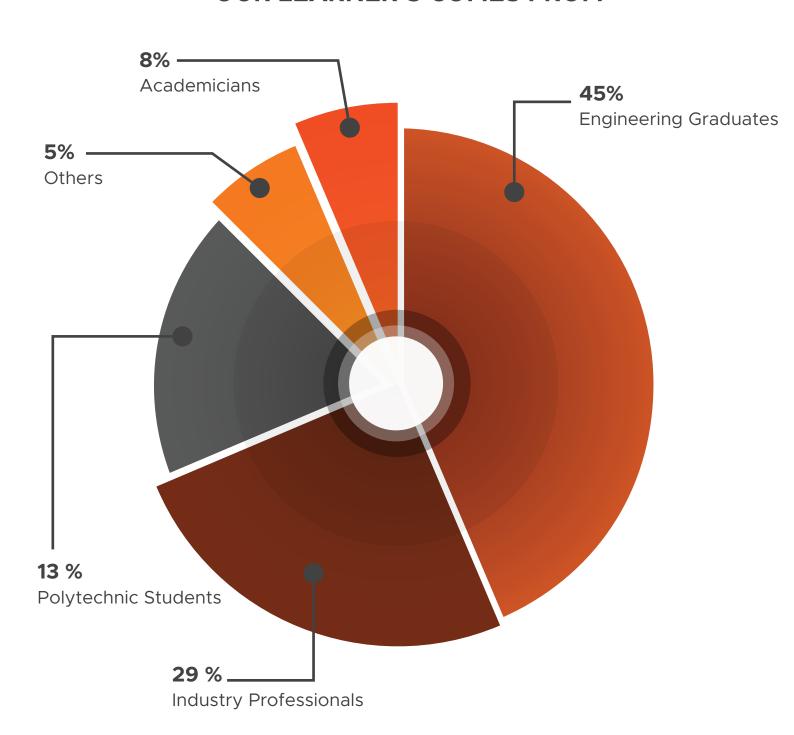
Students will make able to make real time project report on ARAI Testing of 2W EV. Complete process of EV Testing and their expected outcomes.

1 WEEK



## Meet the Class

#### **OUR LEARNER'S COMES FROM**





## Career Support

#### Interview Preperation

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, LinkedIn and Cover Letter prepration 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

#### 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

#### **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



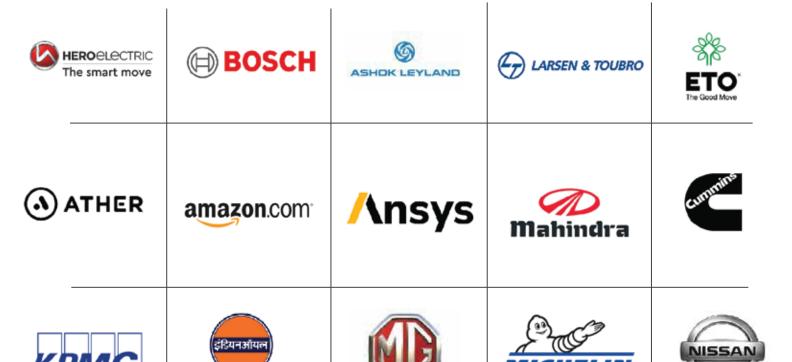
1+ Million
Learners

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 99,999/-

#### **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)**



FOR FURTHER INFORMATION CONTACT

**AMOL SONAWANE** +91-9289291935



#### **COMPANY INFORMATION**