Online MTech Admission in Electric Vehicle (EV) Technology

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Background

The Government of India (GoI) announced National Electric Mobility Mission Plan 2020 (NEMMP 2020) to achieve national energy security and minimize transportation pollution by promoting electric and hybrid vehicles. Indian Automotive Industry wants to become one of the top three countries in the world in global exports of electrical vehicles (EV) and components. Technology development and skilled human resources are vital to achieving the above objectives. The Automotive Industry in India has self-reliance in design, manufacturing in Internal Combustion Engine Technology. However, the Industry is looking for experts in EV technology by training existing skilled manpower through Industry-academia interaction programs especially in battery management, motor operation and, and controllers for efficient supply of power under different drives. Academic Institutes are willing to collaborate with Industry to conduct the research and address challenges in promoting EV Technology.

IIT Hyderabad with its upcoming dedicated test track for autonomous and electrical vehicles, state of art research in battery technology, motor drive and control, is at the forefront of research and development of electric vehicle technologies. It has also incubated a company "PURENERGY" out of its incubation cell. With the launching of many electric vehicles from OEM companies in recent years and coming up of more than 12 startups in Hyderabad, in order to meet the challenges of future workforce in EV, IIT Hyderabad has taken the lead in EV technology research and skill development through Interdisciplinary Master's Program (IDP). This program will be coordinated by a group of 22 faculty members from Mechanical Engineering, Electrical Engineering, Design, Chemical Engineering, Civil Engineering, Physics and Chemistry disciplines with strong focus in EV research and training to offer PG programs as part of the institute initiative of IDP. Through this online MTech Program in EV Technology, IITH reaches out to industry professionals with an objective to upskill them.

The proposed online MTech Program in EV Technologies encompasses the multidisciplinary approach (one of the main pillars of New Education Policy, NEP-2020) to train the workforce in the technology domains of Drives, Transmission, Batteries, Power Electronics, Safety, and Product Design.

Eligibility - Online students need not have GATE qualification. They should have BTech first class (60%) in ME, EE, ECE, CE, and other relevant equivalent degrees and 2 years of industry experience after BTech and they should be currently working in an industry.

Duration: Max 4 Years for MTech (EV) and Max 3 Years for Executive MTech (EV)

A) **MTech (EV) with thesis** – Duration 2-4 Years: 48 Credits (Course credits: 24 + Thesis credits: 24)

- **Courses can be done over 1-3 years**
- **Thesis will be done in the final year only after completing 24 course credits**

***Note*:** Online students will do their project in their own industry and not at IITH. The project can be started only after 24 credits of courses are completed with 7.5 CGPA. During the project each candidate will have a guide from IITH and may have another from his/her industry.

B) **Executive MTech (EV) without thesis**: **Duration 1-3 Years**.

Full Course credits: 24

- **Courses can be done over 1-3 years.**

Admission Schedule and Procedure:

- **Application starts every March-April, and the new session starts from July end/ August beginning**

Please visit: https://cip.iith.ac.in/ or https://www.iith.ac.in/academics/post-graduate/ or https://www.iith.ac.in/mtechadmissions/ for admission announcement

In case of any queries, contact acad.pd@iith.ac.in office.cip@iith.ac.in pkumar@mae.iith.ac.in

Fees:

IITH online fee structure

Online MTech: (24 Course Credits and 24 Thesis Credits = 48 Credits)

a) The following courses will be offered for 24 credits

Course Id	Course name	Cr
ME5719	Design of EV	2
ME5809	Testing & Certification of EV	1
ME5899	Structural Optimization	2
EV51791	Introduction to lightweight	1
ME5429	FEM Lab	1
ME5449	CFD Lab	1
EE5219	Power Converter Design	3
ET5269	Electric Vehicles	1
EE5260	Automotive communication and sensing	3
IS5039	Embedded Programming	3
ET5029	Electrochemical Energy Storage Systems: Batteries, Fuel, Cells and Super capacitors	3
ET5249	Hydrogen Economy	2
ET5219	Energy conversion and storage devices Lab	2
DS5349	Advanced Materials in Design	3
DS5449	Life-Cycle analysis for EV	2

Thesis Stage 1 and 2

Course code	Name of the course	Credit
EV6115	Thesis - 1	12

Course code	Name of the course	Credit
EV6125	Thesis - 2	12

Note: Course Credits: 24 (1-6 Semesters) + Thesis Credits: 24 (after completion of course credit).

I) Faculty members associated with EV Course: 28

S. No.	Name of Faculty/Department
1	Prof. Ashok Kumar Pandey, MAE
2	Prof. B Venkatesham, MAE
3	Prof. Nishant Dongari, MAE
4	Prof. Surendra Kumar Martha, CY
5	Prof. Shishir Kumar, EE
6	Prof. Jose Titus, EE
7	Prof. Ch.Subrahmanyam, CHY
8	Prof. Pradeep Yemula, EE
9	Prof. Narendra Kurra, CHY
9	Prof. Prabhat Kumar, MAE
10	Prof. Abhinav Kumar, EE
12	Prof. Shiva Ji, DS
13	Prof. Srikar A V R, DS
14	Prof. Sai Santosh Kumar Raavi, PHY
15	Prof. P Rajalakshmi, EE
16	Prof. Rupesh Wandhare, EE
17	Prof. Deepak John Mathew, DS
18	Prof. Prasad Onkar, DS
24.	Prof. R. Gangadharan, MAE
25.	Prof. Raja Banerjee, MAE
26.	Prof. Pankaj Kohle, MAE
28.	Prof. Sai Sidharth, MAE

Course Content

Course Code:ME5710

Course Name: Design of EV
Credits: 2
Course type: theory
Prerequisites: None

Course Syllabus:

Introduction to Electrical Vehicles, EV Subsystems, Design of EV Drivetrain, Battery Performance Parameters, Mechanical and Thermal Design of EV, Noise and Vibration requirements.

References:

1. Husain, I. (2021). Electric and Hybrid Vehicles: Design Fundamentals. United Kingdom: Taylor & Francis Group.

2. M. Ehsani, Y. Gao, S. Gay and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press, 2005.

3. C. C., Chau, K. T. (2001). Modern Electric Vehicle Technology. United Kingdom: Oxford University Press.

Course Code:ME5800

Course Name: Testing and Certification of EV
Course type: theory
Prerequisites: None

Course Syllabus:

Electric vehicles are the future of transportation. Electric mobility has become an essential part of the energy transition strategy and will result in significant changes for vehicle manufacturers, governments, companies and individuals.

In this course, you will gain comprehensive knowledge on various tests that are conducted on an electric vehicle, in order for it to qualify for final certification and approval for mass production and introduction into the market. It will help engineers and managers to make

appropriate improvements and strategic decisions on their electric vehicle products and their implications.

Battery performance safety test- Evaluation testing of Battery as per AIS 048, ECE R100, USABC, etc., performance testing, life-cycle testing and safety/abusive testing, Material Characterization of battery electrodes and electrolytes.
Electric Motor Characterization – Net Power, Power & Efficiency as per AIS 041, ECE R85. Reliability, durability and overload capacity. Evaluation of torque, speed, motor characteristics Regenerative braking test. Thermal Characteristics.

Durability Tests of Electric Vehicle – Lab simulation of tracks. Simulations for environmental conditions like temperature and humidity.

Vehicle Performance on Chassis Dynamometer and Test Tracks – Electric energy consumption as per AIS 039 and ECE R101. Electric range as per AIS 040 and ECE R101. Power at wheels as per AIS 041. Brakes, gradeability, noise.

Charger Testing and Certification – Testing as per AIS 138, Testing as per Bharat EV Charger specification AC001 and DC001.

Reference:

1.Standards as per ARAI, Pune. https://www.araiindia.com/

2. Standards as per the production of the e-motor company, https://pureev.in/

Course code: EE5210

Course Name: Power Converter Design
Credits: 3
Course type: Theory, Core or Elective
Prerequisite: Basic Power Electronics (from Btech curriculum or hands-on experience in Industry)
Course syllabus: Characteristics of power electronic switches, Drive circuits, Voltage and current sensing mechanism, Introduction to Human Machine Interface, Basics of DC-DC converters, DC/AC inverters (single phase and three phases) and PWM Control techniques, Modelling procedures of the power converters, State space averaging, Linearization, Designing of the close loop control of a power converter, AC to DC rectifiers (single phase/three-phase), analysis and performance with passive loads: **References:**
1. DC-DC Switching Regulator Analysis by Daniel M. Mitchell ;
2. Voltage Sourced Converters in Power Systems: Modeling, Control, and Applications by Amirnaser Yazdani, Reza Iravani

Course Code: ET5020
Course Name: Electrochemical Energy Storage Systems: Batteries, Fuel Cells and Supercapacitors
Credits: 2

Course type: theory
Prerequisites: None

Course Syllabus:Principles of Operation of Cells and Batteries; Electrochemical Principles and Reactions; Factors Affecting Battery Performance; Battery Design; Primary Batteries; Secondary Batteries: Advanced Lead-acid, Ni-based and lithium ion batteries (Fundamentals, Materials, Electrode preparation, Battery Assembly, Testing, Failure Analysis, Safety issues); Flow Batteries; Next Generation Batteries; Fuel cells, Supercapacitors, Selection and Application of energy storage systems for UPS, Solar, Telecom, Aerospace, Grid and Electric Vehicle Systems.

References

1. Kirby W. Beard. Linden's Handbook of Batteries, Fifth Edition (McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2019).
2. Vladimir S. Bagotsky, Alexander M. Skundin and Yury M. Volfkovich (A.N. Frumkin Institute of Physical Chemistry and Electrochemistry of the Russian Academy of Science, Russia) Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors" By, John Wiley & Sons Inc, New Jersey, USA, 2015, 372 pages, ISBN: 978-1-118-46023-6.
3. Ying-Pin Chen, Sajid Bashir, Jingbo Louise Liu, Nanostructured Materials for NextGeneration Energy Storage and Conversion: Advanced Battery and Supercapacitors, Springer Nature, 10-Oct-2019 - Technology & Engineering - 472 pages.
4. D. Pavlov, Lead-Acid Batteries: Science and Technology, Elsevier 31-May-2011 - Technology & Engineering - 656 pages.
5. C. Vincent, Bruno Scrosati, Modern batteries, Elsevier, 26-Sep-1997 - Technology & Engineering - 368 pages.

Course Code:DS5453

Course Name: Advanced Materials in Design
Credits: 2
Course type: theory
Prerequisites: None

Course Syllabus:
This course aims to teach students knowledge of advanced materials and processes from a design perspective. With a theoretical and hands-on experimental approach, students comprehend all the different possibilities that the industry provides to transform matter.

Materials Overview, Classification, Properties and usage of thermoplastics, thermosetting plastics. Process of selection and applications of plastics for engineering and consumer products.

Design Limitations and specific advantages of plastic modelling processes. Concepts of structure and costing. Significance of form in structural strength of products. Influence of materials and processes on product aesthetics. Industrial finishes for plastic, wood and metals.

Properties and use of rubber, ceramics and glass. Overview of natural materials- wood, bamboo, cane, leather, cloth, jute and paper and their use at craft and industrial levels

References:

1. Beadle, John D : Product treatment and finishes, Macmillan, London 1971
2. Beck R. D.: Plastic Product Design, Van Nostrand Reinhold Co., New York, 1980
3. Cleminshaw D., Design in Plastics, Rockport Publishers Inc. (22 February 1994)
4. Garratt J.: Design and Technology, Cambridge University Press, UK, 2004
5. Thompson R.: Manufacturing processes for design professionals, Thames & Hudson, London 2007
6. Ashby, Michael; Johnson, Kara; Materials and Design: The Art and Science of Material Selection in Product Design, Publisher: Butterworth-Heinemann; 2002

Course Code:DS5443

Course Name: Life-Cycle analysis for EV
Credits: 2
Course type: theory
Prerequisites: None

Course Syllabus: The environmental impacts of electric vehicles (EVs) need to be addressed before it becomes the next generation of vehicles commonly owned by the people. Certain battery types are already on the radar of environmental concerns owing to their hazardous nature of elements used and their disposal. The same needs to be checked and understood for minimizing the impacts. A component wise analysis is imperative to understand the factors influencing the environmental impact of EVs from LCA perspective. A quantitative ecological assessment of various stages such as EV charging, battery footprint, real world emissions, realistic lifetime mileages, comparative emissions of EVs,.

Reference:

1. Hauschild, Michael Z., et al. 2018. Life Cycle Assessment. Springer
2. Giudice, Fabio. 2006. Product Design for the Environment. Taylor & Francis

Course Code: **IS5033**

Course Name: Embedded Programming
Credits: 3
Semester Schedule: Even Semester
Course type: theory
Prerequisites: None

Course Syllabus: Introduction to Embedded Systems, Architectures of embedded processors, Memory hierarchy and its management Basics of Microcontrollers –timers, interrupts, analogy to digital conversion, bootloaders Interaction with devices -buses, memory management, device drivers and wireless comm., Interfacing sensors, actuators and peripherals. Real-time principles -multi-tasking, scheduling, synchronization Building low-power high-performance systems – code profiling and optimization Architecture, Case Studies of Real time. Microcontrollers/Microprocessor: Arduino, Raspberry-pi, ARM, FPGA, ESP32, RL78etc)

Course Code: ET5211

Course Name: Energy conversion and storage devices Lab
Credits: 2
Semester Schedule: Even Semester
Course type: Lab
Prerequisites: ET5020

Course Syllabus: Material Synthesis, Electrode Preparation, Lead-acid and Li-ion cell assembly, Battery charge-discharge, life-cycle studies, CV, EIS, Chronoamperommetry and potentiommetry, LSV, Solar cell testing.

Course Code: ET5240

Course Name: Hydrogen Economy
Credits: 2
Semester Schedule: Even Semester
Course type: Lab
Prerequisites: ET5020

Course Syllabus: Hydrogen-based energy carrier and storage, Sustainable application, highefficiency hydrogen conversion devices, Production and storage of hydrogen, Hydrogen Storage in Advanced Solid State and Liquid Materials.

Course Code: EV5269
Course Name: Electric vehicles

Credits: 1
Semester Schedule: Even Semester
Course type: theory
Prerequisites: EV5029

Course Syllabus: Introduction, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Vehicle Dynamics, drive train design methodology and control principles, Battery-fuel cell-super capacitor requirements, BMS, Advantages and disadvantages of EVs.

Course Code:ME5670

Course Name: Vehicle Dynamics and Modeling
Credits: 3
Semester Schedule: EVEN Semester
Course type: theory
Prerequisites: None

Course Syllabus: Vehicle Mechanics - Forces under static and dynamic equilibrium. Free body diagram of different vehicle components. Simple linearized rigid models of different components. Dynamic stability and the vehicle performance under different operating conditions such as understeering, neutral steering, and oversteering. Concept of vehicle ride comfort. Vehicle stability controls. Driveline models, Performance characteristics of a comfortable vehicle ride. Introduction to the development of vehicle model using different software such as MATLAB Simulink, MAPLESIM, System Modeller, ADAMS, CarSIM.
Course Code: SM5043

Course Code:ME5139

Course Name: Finite Element Method
Credits: 3
Course type: theory
Prerequisites: None

Course Syllabus: Theory and implementation of finite element methods for solving boundary value problems in solid mechanics. Mathematical foundations (Calculus of Variation), review of energy theorems, theory and implementation of 1D, 2D, and 3D elasticity problems. Introduction to FEM softwares.

Course Code: ME5421

Course Name: FEM LAB
Credits: 1
Semester Schedule: Odd Semester
Course type: theory/computational Lab

Prerequisites: None

Course Syllabus: Finite element methods for solving boundary value problems in solid mechanics. Introduction, Spatial Modelling, Geometric discretization, Element Library, Material Modelling, Loading and Boundary Conditions, Constraints, Surface/Interfaces modelling, Step and job handling and Post-processing. FEA Implementation and Visualization of 1D Problems, Truss Problem, Beam bending, Plane and axisymmetric Problems and 3D problems. Various analysis such as, Static, Transient, Harmonic, Modal, Dynamics and Multi Physics (Thermomechanical, etc).

References

1. R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, "Concepts and Applications of Finite Element Analysis", Wiley, 2001.
2. O. C. Zienkiewicz and R. L. Taylor, J. Z. Zhu, "The Finite Element Method: Its Basis and Fundamentals", Butterworth-Heinemann, 2013.
3. A. F. Bower, "Applied Mechanics of Solids", Online Resource: http://solidmechanics.org/, CRC Press, Taylor & Francis, 2010.
4. R. J. Boulbes, "Troubleshooting Finite-Element Modeling with Abaqus", Springer, 2020.

Course Code:ME5480

Course Name: Sustainable Energy Technology: Energy Sources, Energy Efficiency, Storage and Optimization
Credits: 3
Semester Schedule: ODD Semester
Course type: theory
Prerequisites: None

Course Syllabus: Introduction: Review of thermodynamics; Energy Demand and Supply Outlook; Climate Change: projections and risks. Non-renewable Energy sources (Coal, Oil, Natural Gas, Nuclear) and their impact on the environment (climate change , atmospheric pollution, radioactive waste); Renewable Energy Sources - Wind, Solar PV, Solar-Thermal, Geo-thermal, Hydropower – technology and deployment; Carbon Neutral Fuels – biomass to fuel conversion, biofuel combustion technology, hydrogen as fuel, CO2 to fuel conversion, fuel cell technology; Energy Storage Technology – chemical storage and battery technology, electro-mechanical storage, thermal storage; Energy Efficiency and Emission Reduction – Use of Exergy to optimize energy use, Clean Combustion Technology, Carbon Capture and Storage, Energy efficient buildings, Life Cycle Assessment (LCA), Distributed Energy and Smart Grid systems.

Course Code:ME5040

Course Name: Computational Fluid Dynamics Tools
Credits: 1.5
Semester Schedule: Even Semester
Course type: theory/computational Lab
Prerequisites: None

Course Syllabus: Introduction to Navier Stokes equation, basics of discretization methods, finite volume formulation of convection-diffusion equation, pressure-velocity coupling, boundary condition implementation, mesh generation techniques in CFD, CFD applications in manufacturing processes through examples - heat removal during machining process, laser welding process, casting, spray coating process.

Course Code: SM5033

Course Name: Internet of Things (IoT)
Credits: 1
Semester Schedule: Summer Semester
Course type: theory
Prerequisites: None

Course Syllabus: Introduction: Concept, Importance, Interdisciplinary, Challenges, Various applications/smart objects, Major Players/Industry, Iot Node and Network architecture, Communication technologies, Smartness, Handson with Iot platforms

Recent Activities in EV@IITH

State of Art Test Bed

TiHAN-IIT Hyderabad

DST NM-ICPS TiHAN at IIT Hyderabad is taking up a magnanimous effort in building a unified and state of the art testbed for the development of autonomous navigation systems used in ground and aerial vehicles

Innovation in Battery Research

Energy News / Latest Energy News / Power

INNOVATION: IIT Hyderabad develops dual carbon alternative to lithium-ion batteries

The Electrochemical Energy Storage Lab at the Indian Institute of Technology Hyderabad (IITH), has developed a 5V Dual Carbon Battery utilising self-standing carbon fibre mats as both electrodes - cathode and anode.

IANS - April 05, 2021, 14:45 IST

EDUCATION LATEST EXAMS SCHOOL CAMPUS

Home / Education / IIT Hyderabad-Incubated Startup To Launch Electric Motorcycle

IIT Hyderabad-Incubated Startup To Launch Electric Motorcycle

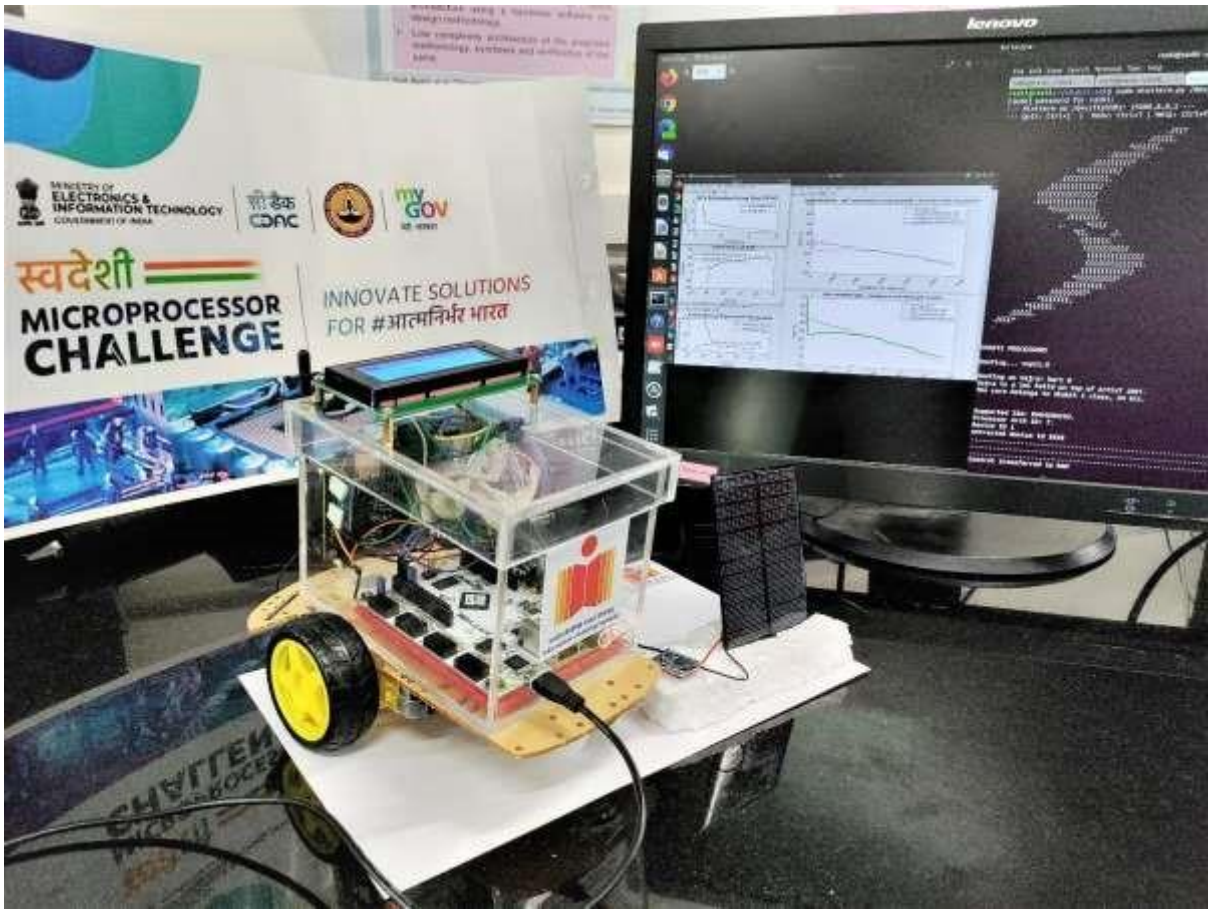
An Indian Institute of Technology Hyderabad's incubated startup named PURE EV will be launching the first-ever electric motorcycle labelled as ETRYST 350.

Education | Written By Shivanika Aggarwal | Updated: Feb 11, 2021 3:57 pm IST

TiHAN Testbed on Autonomous Navigations

CARGO DELIVERY DRONE TESTING

SMART BATTERY MANAGEMENT SYSTEM USING IOT




3.7 V Li-Ion Cell
5V Dual Carbon Cell
2V/ 2Ah Lead-acid cell
2V Lead-carbon ultracapacitor


IIT Hyderabad & Suzuki Motor Corporation
collaborates for India-specific Autonomous Car - ADAS
Technology Development

Testimonial from registered students:

Mr. Gyan Swaroop (HEROMOTOCORP) || EV21MTECH15004

"It is my privileged, to join such a professional course, it will instrumental my knowledge and analytical skill to a new height, and will able to fulfill the India future requirements of Atmanirbhar Bharat."

"Additional Courses can be proposed: PMSM machine and control , BMS design and development, AI and machine learning for BMS design and control."

Deepak Pokhariyal (BHEL, Bangalore) || EV21MTECH15009

"In today's fast changing era, all industries now focus on high productivity with optimized head counts. The M. Tech. (EV Tech) program has an excellent curriculum, assessments and exam patterns. This program has definitely helped me to enhance my skills as an engineer. I feel honored to be an alumni of IITH."

Sai Kiran Parimi Venkata Shiva (ARAI, Pune) || EV22MTECH15003

"The course is intended for Working professionals and the stakeholders of the EV revolution. It serves its purpose in providing basic to advanced technical knowledge transfer about the Mechanical, Electrical and Computational elements in Electric Vehicle Engineering. Students can choose electives in the field, which they wish to gain expertise in and can learn about the evolving technologies as well. The Dynamic method of having electives, online teaching and recordings is what Working professionals can benefit from, with good support from the faculty and the institution."